

ORIGINAL

NEW APPLICATION



Intermodal Transportation



0000166261

John S. Halikowski, Director  
Dallas Hammit, State Engineer  
Steve Boschen, Division Director

RECEIVED

2015 SEP 24 P 10 25

September 4, 2015

Arizona Corporation Commission  
Office of Railroad Safety  
Attn: Chris Watson  
1200 W Washington Street  
Phoenix, AZ 85007

ARR 0000 SC NOG SR214 01X  
DOCKET CONTROL

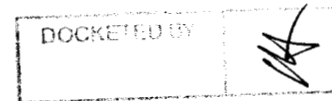
RR-03639A-15-0332

RE: Application to modify existing railroad signal  
Project: Calle Sonora, east of SR 19B in Nogales, Arizona  
Federal Project #SLP-0(201)T  
ADOT TRACS # 0000 SC NOG SR214 01X  
AAR/DOT # 742-037N

Arizona Corporation Commission

DOCKETED

SEP 24 2015



Mr. Watson,

This application is being submitted to allow a modification and upgrade of the gate and flasher units and an upgrade of the advance preemption on Calle Sonora.

**1. Project Location and Description**

The project is located at the crossing of Union Pacific Railroad (UPRR) on Calle Sonora east of 19B in Nogales, Arizona. This crossing currently consists of one mainline track with daily usage. The crossing is at-grade and the roadway is used for two-way traffic consisting of one right/left/thru westbound lane and one thru eastbound lane. The current crossing protection includes lights and gates on the outside edges of the road and simultaneous preemption.

The project consists of Union Pacific RR constructing the railroad signal improvements.

- Both gate/flasher units will be upgraded
- Signal Bungalow finished floor raised due to flooding
- Advance Preemption equipment will be installed and connected to the traffic signal
- Constant warning time train detection upgrade

Prior to the installation of this railroad signal upgrade, and as part of a separate ADOT project, the following items will be constructed and installed. See "EXHIBIT ADOT PROJECT-STRIPING/TRAFFIC PRE-EMPTION".

- Paint striped median
- Traffic signal pre-emption equipment

**2. Why the crossing is needed**

Based on the 2012 crossing improvement array, the Calle Sonora crossing was selected for upgrades to the signal and preemption.

**3. Construction Phasing**

Once the utility, environmental, and right-of-way clearances are obtained, ADOT can apply for and receive FHWA construction authorization and authorize UPRR to order their signal materials. Once an Opinion and Order is issued, UPRR will modify the signal equipment. The railroad signal improvements will be installed by UPRR within 15 months of the receipt of an Opinion and Order from the ACC.

**4. Maintenance of the crossing**

UPRR will be responsible for installing and maintaining the railroad signal equipment. The City of Nogales is responsible for maintaining road approaches, signing and striping outside of UPRR responsibility.

**5. Project Funding**

Project funding will be provided by the Federal Highway Administration thru their Section 130/Railroad-Highway Crossing Safety improvement program.

Signal	
Labor	\$166,773.00
Material	<u>\$199,541.00</u>
Total Project Cost	\$366,314.00

**6. Other information (based on typical Staff Data Requests):**

1. Provide Average Daily Traffic Counts for each of the locations.  
2012 Average Daily Traffic = 4,027 vehicles per day per the May 2014 Safety Assessment Report for this crossing.
2. Please describe the current Level of Service (LOS) at each intersection.  
ADOT is not aware of an established a LOS value.
3. Provide any traffic studies done by the road authorities for each area.  
A Safety Assessment Report was produce for ADOT at this location in May 2014.
4. Provide the population of the City the crossing is located in.  
2014 population estimate (SEAGO Transportation Section): 21,647 persons.
5. Provide what warning devices are currently installed at the crossing.  
Currently there are flashing lights and gates on the outside edges of the roadway for both eastbound and westbound traffic.
6. Provide distances in miles to the next public crossing on either side of the proposed project location. Are any of these grade separations?  
There is an at-grade crossing at Baffert (742-036G) 0.25 mile to the north. There's an at-grade crossing on Bankard (742-038V) 1.1 miles to the south. Both of these crossings are along 19B.

7. How and why was grade separation not decided on at this time? Please provide any studies that were done to support these answers.

Grade separation was not considered as part of this Section 130 safety upgrade because the crossing does not meet any of the criteria outlined in the FHWA-Grade Separation Guidelines.

8. If this crossing was grade separated, provide a cost estimate of the project.

Estimate \$30,000,000++.

9. Please describe what the surrounding areas are zoned for near this intersection. i.e. Are there going to be new housing developments, industrial parks etc.

According to the City of Nogales current Zoning Map, the areas around the crossing are zoned Light Industrial.

10. Please supply the following: number of daily train movements through the crossing, speed of the trains, and the type of movements being made (i.e. thru freight or switching). Is this a passenger train route?

Per the FRA, there are 2 day-thru and 3 night-thru trains. No switching trains are reported. The trains move over the crossing at speeds between 15 mph and 20 mph. There is a maximum time table speed of 25mph.

11. Please provide the names and locations of all schools (elementary, junior high and high school) within the area of the crossing.

- Nogales High School 1905 N Apache Blvd, Nogales, AZ

12. Please provide school bus route information concerning the crossing, including the number of times a day a school bus crosses this crossing.

Per Santa Cruz Valley Unified District, Santa Cruz Valley Union High School District and Nogales Unified District – school busses cross these tracks 9 times per day.

13. Please provide information about any hospitals in the area and whether the crossing is used extensively by emergency service vehicles.

Carondelet Holy Cross Hospital 1171 W Target Range Rd, Nogales, AZ  
Calle Sonora is not a major emergency service route.

14. Please provide total cost of the railroad improvements to each crossing.

Cost described above.

15. Provide any information as to whether vehicles carrying hazardous materials utilize this crossing and the number of times a day they might cross it.

The City of Nogales states that it's not aware of any vehicles carrying hazardous materials utilizing this crossing.

16. Please provide the posted vehicular speed limit for the roadway.

25 MPH

17. Do any buses (other than school buses) utilize the crossing, and how many times a day do they cross the crossing.

ADOT is not aware of any.

18. Please indicate whether any spur lines have been removed within the last three years inside a 10 mile radius of any crossings covered in this application. Please include the reason for the removal, date of the removal and whether an at-grade crossing or crossings were removed in order to remove the spur line.

None.

19. Please fill in the attached FHWA Grade Separation Guidelines Table, (from FHWA's 2007 revised second edition Railroad Highway Grade-Crossing Handbook, page 151) with a yes or no answer as to whether each item applies. Also, please provide all information to support your answers of yes or no (i.e. vehicle delay numbers, any calculations that were performed to get the answers).

20. Based on the current single track configuration at the crossings specified by this application, please provide the current traffic blocking delay per train. Please indicate the time in which vehicular traffic is delayed (1) to allow the train to pass at a crossing and (2) due to trains stopped on the track for any purpose. The delay is measured from the point that the warning devices are activated at the crossing to the time after the train has cleared the crossing and the warning devices are reset.

The City of Nogales has no information or complaints regarding delays however the delay at the crossing is really a function of the average length of the train and the average speed that is traveling.

FOR EXAMPLE: 7,000 ft. train traveling 30mph (44 fps) would result in 160 seconds or a little over 2.5 minutes of delay.

Sincerely,

DocuSigned by:

*Jason Pike*

305F0D5C5F9F42E...

Jason Pike

Railroad and Utility Coordinator  
Arizona Department of Transportation  
205 S. 17th Ave, Room 357 MD 618E  
Phoenix, AZ 85007  
Phone: 602-712-7149  
jpik@azdot.gov

**FHWA - GRADE SEPARATION GUIDELINES (Calle Sonora, Nogales, AZ, DOT#742-037N)**

Highway-rail grade crossings should be considered for grade separation or otherwise eliminated across the railroad right of way whenever one or more of the following conditions exist:

		CALLE SONORA	
The highway is a part of the designated Interstate Highway System	Crossing Currently meets the criteria	N	
The highway is otherwise designed to have full controlled access	Crossing meets the criteria by 2030	N	
The posted highway speed equals or exceeds 70 mph	Crossing Currently meets the criteria	N	
	Crossing meets the criteria by 2030	N	
AADT exceeds 100,000 in urban areas or 50,000 in rural areas	Crossing Currently meets the criteria	N	
	Crossing meets the criteria by 2030	N	
Maximum authorized train speed exceeds 110 mph	Crossing Currently meets the criteria	N	
	Crossing meets the criteria by 2030	N	
An average of 150 or more trains per day or 300 million gross tons/year	Crossing Currently meets the criteria	N	
	Crossing meets the criteria by 2030	N	
Crossing exposure (trains/day x AADT) exceeds 1M in urban or 250k in rural; or passenger train crossing exposure exceeds 800k in urban or 200k in rural	Crossing Currently meets the criteria	N	
	Crossing meets the criteria by 2030	N	
Expected accident frequency for active devices with gates, as calculated by the US DOT Accident Prediction Formula including five-year accident history, exceeds 0.5	Crossing Currently meets the criteria	N	
	Crossing meets the criteria by 2030	N	
Vehicle delay exceeds 40 vehicle hours per day	Crossing Currently meets the criteria	N	
	Crossing meets the criteria by 2030	N	

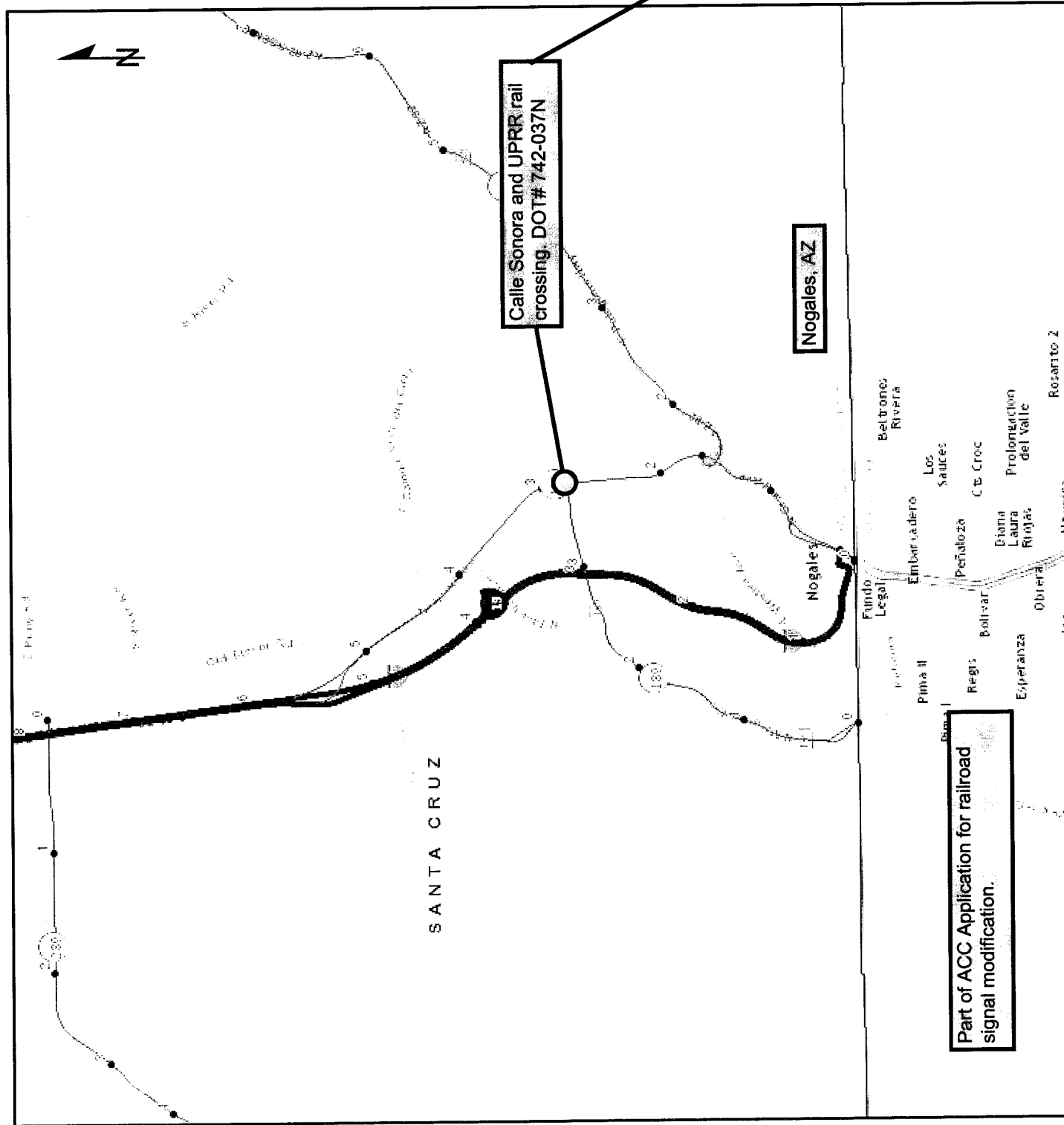
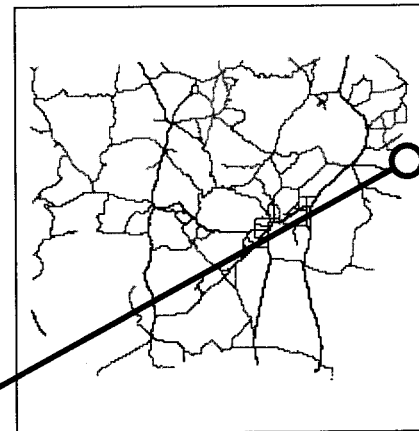


# Calle Sonora @ UPRR 742-037N

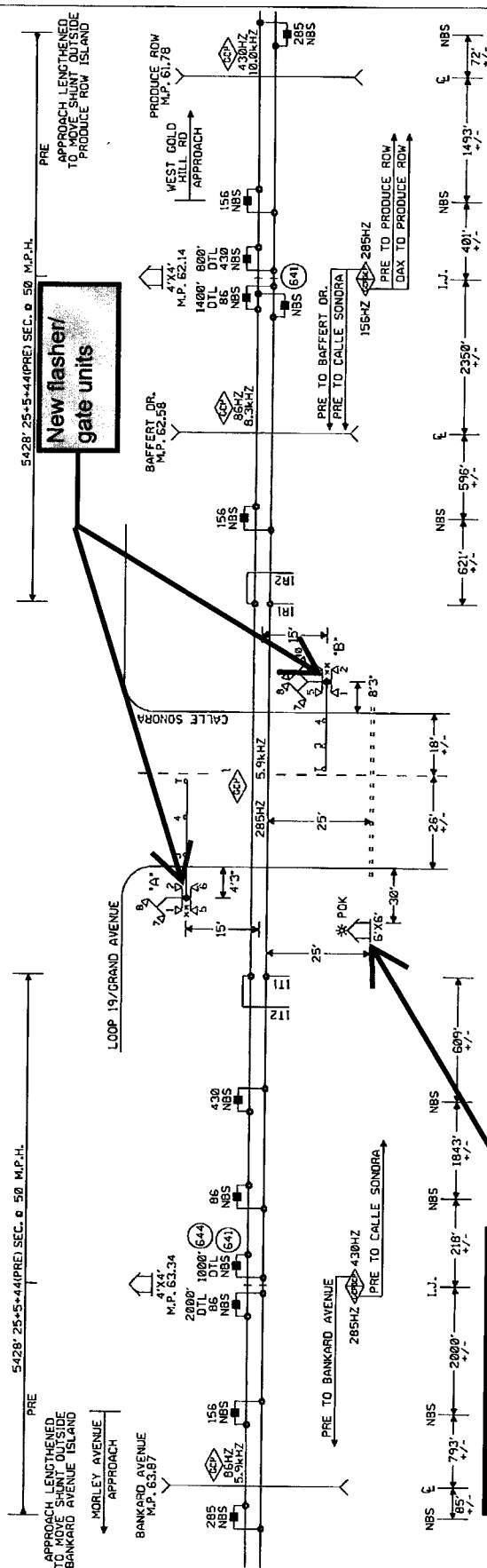
Calle Sonora at UPRR Crossing  
DOT#742-037N, RRMP 62.83.  
East of SR 19B, MP 2.8 in  
Nogales, AZ

0 0.5 1 2 Miles

1:72,224



PRIME WARNING TIME = 23 SECONDS  
PREEMPT WARNING TIME = 69 SECONDS



**New Bungalow. Finished floor to be raised**

NOTES:

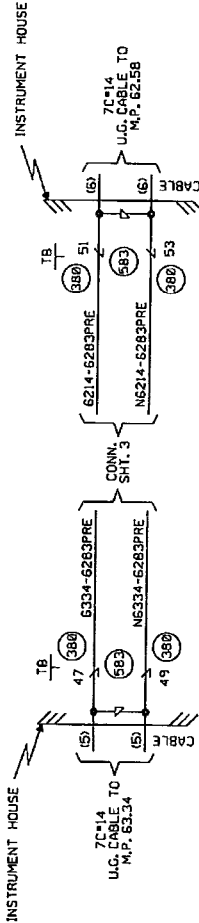
- ⊗ TWISTED WIRES INSULATED 1 TWIST PER FT. ALL TRACK WIRES 2C. #6
- TRANSMITTER AND RECEIVER LEADS TO BE SEPARATED BY AT LEAST 12" IN TRENCH. LENGTHS SHOULD NOT EXCEED MANUFACTURER'S RECOMMENDATION.
- TOP OF FOUNDATION TO BE AT SAME ELEVATION AS TOP OF SIGNAL. THE SIGNAL SHALL NOT BE MORE THAN 4" ABOVE THE SURFACE OF THE GROUND.
- ALL BUNGALOW WIRING TO BE #16 AWG FLEX. UNLESS OTHERWISE SPECIFIED EXCEPT ALL GROUND WIRE TO BE #6 AWG FLEX OR LARGER.
- ALL WIRING IN GATE MECHANISM TO BE #10 AWG FLEX.
- REFER TO UP STANDARD DNG FOR BUNGALOW GROUNDING.
- PORTABLE GENERATOR EXTENSION CORD FOR 240V TO 240V IS PROVIDED AS WELL AS A 120V TO 240V ADAPTER.
- ALL LIGHTS TO BE 12" ROUNDELS.
- ===== 4" X 76 CONDUIT
- LIGHTS: LED LIGHTS
- GATE A: 30'
- GATE B: 25'
- xx = BELL

TRK 1 ISLAND DISTANCE 144' MINIMUM 120' REQUIRED  
PREFERRED ISLAND WIRE CONNECTIONS ARE A MINIMUM 50' FROM EDGE OF ROAD

OFFSET AND ISLAND DISTANCES TO BE VERIFIED BY FIELD

WIS ← ○ → (EN)

CABLE TABULATION  
CABLE NO. 5 7C\*14 U.G.B.T. HOUSE TO M.P. 63.34  
CABLE NO. 6 7C\*14 U.G.B.T. HOUSE TO M.P. 62.58



CONSTRUCTION NOTES:

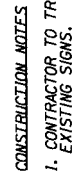
1. CONSTRUCT CONCURRENT WITH W.D. #s 27032, 27034, 27036, 27037, & 27038.
2. ORDER AND INSTALL (1) R/C CORD (80412) AT THIS LOCATION.
3. ORDER AND INSTALL (4) RELAYS (TAB 884) AND (1) RELAY (TAB 889) FOR PREEMPTION AT THIS LOCATION.
4. ORDER AND INSTALL (2) RELAY RACKS (TAB RACK2) AT THIS LOCATION.
5. ORDER AND INSTALL 4'X4' REMOTE CABIN WITH (1) 2-TRACK GCP (TAB 698), 812-X BATTERY (TAB 815), AND RECTIFIER (TAB 575) AT M.P. 63.34.
6. ORDER AND INSTALL 2000' 7C\*14 CABLE FOR DAX FROM M.P. 63.34.
7. ORDER AND INSTALL 3000' 7C\*14 CABLE FOR DAX FROM M.P. 63.34.
8. IF W.D. #s 27035 AND 27036 ARE CONSTRUCTED PRIOR TO W.D. #s 27032 AND 27034, THEN AT M.P. 63.87 CHANGE EXISTING GCP FREQUENCY TO 970HZ AND CHANGE ENI HWS TO A 970HZ NBS. AT M.P. 63.34, DISABLE THE TRACK TO BANKARD OUTPUT.
9. UPRR TO INSTALL CONDUIT FOR PREEMPTION INTERCONNECT CABLE.

NEW SHEET

UNION PACIFIC RAILROAD		NOGALES, ARIZONA		NOGALES SUBDIVISION	
DATE	11/11/14	DESIGN	WFL	DOT	742037N
LAST LEVEL CHECKED	DU	LAST LEVEL BY DESIGNER	DU	MP	62.83
CHANGED FROM TYPICAL?	Y	CHANGED FROM TYPICAL?	Y	ID	8446283.1X
REVISION	1	DATE	11/11/14	BY	WFL
REVISION	2	DATE	11/11/14	BY	WFL
REVISION	3	DATE	11/11/14	BY	WFL
REVISION	4	DATE	11/11/14	BY	WFL
REVISION	5	DATE	11/11/14	BY	WFL
REVISION	6	DATE	11/11/14	BY	WFL
REVISION	7	DATE	11/11/14	BY	WFL
REVISION	8	DATE	11/11/14	BY	WFL
REVISION	9	DATE	11/11/14	BY	WFL
REVISION	10	DATE	11/11/14	BY	WFL
REVISION	11	DATE	11/11/14	BY	WFL
REVISION	12	DATE	11/11/14	BY	WFL
REVISION	13	DATE	11/11/14	BY	WFL
REVISION	14	DATE	11/11/14	BY	WFL
REVISION	15	DATE	11/11/14	BY	WFL
REVISION	16	DATE	11/11/14	BY	WFL
REVISION	17	DATE	11/11/14	BY	WFL
REVISION	18	DATE	11/11/14	BY	WFL
REVISION	19	DATE	11/11/14	BY	WFL
REVISION	20	DATE	11/11/14	BY	WFL

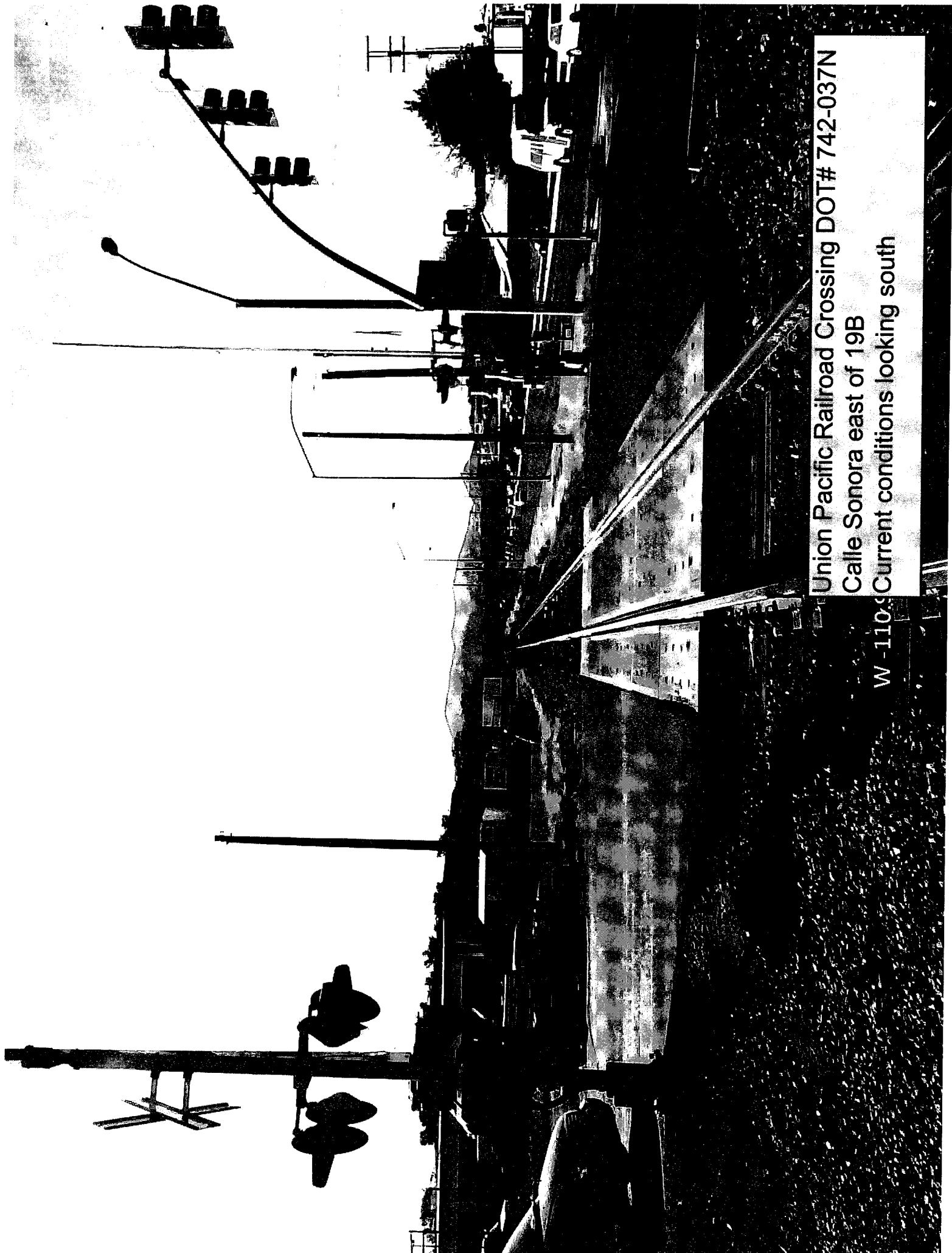
Part of ACC Application for railroad signal modification.  
Calle Sonora east of 19B, Nogales, AZ  
UPRR DOT# 742-037N

Part of ACC Application for railroad  
signal modification. Calle Sonora east of  
19B. Nogales, AZ  
UPRR DOT# 742-037N



PRELIMINARY		STAGE V		PRELIMINARY	
ARIZONA DEPARTMENT OF TRANSPORTATION		INTERMODAL TRANSPORTATION DIVISION		TRACCS NO. H8394 01C	
TRAFFIC DESIGN SERVICES		PAVEMENT MARKING AND SIGNING		SR 19B INTERNATIONAL BORDER - MARIPOSA ROAD/SR 19B	
STA 14+00 TO STA 14+50		STA 14+00 TO STA 14+50		B19-A1201T	
DATE		DATE		DATE	
DESIGN	04/15	DESIGN	04/15	DESIGN	04/15
BY	04/15	BY	04/15	BY	04/15
CHECKED	04/15	CHECKED	04/15	CHECKED	04/15

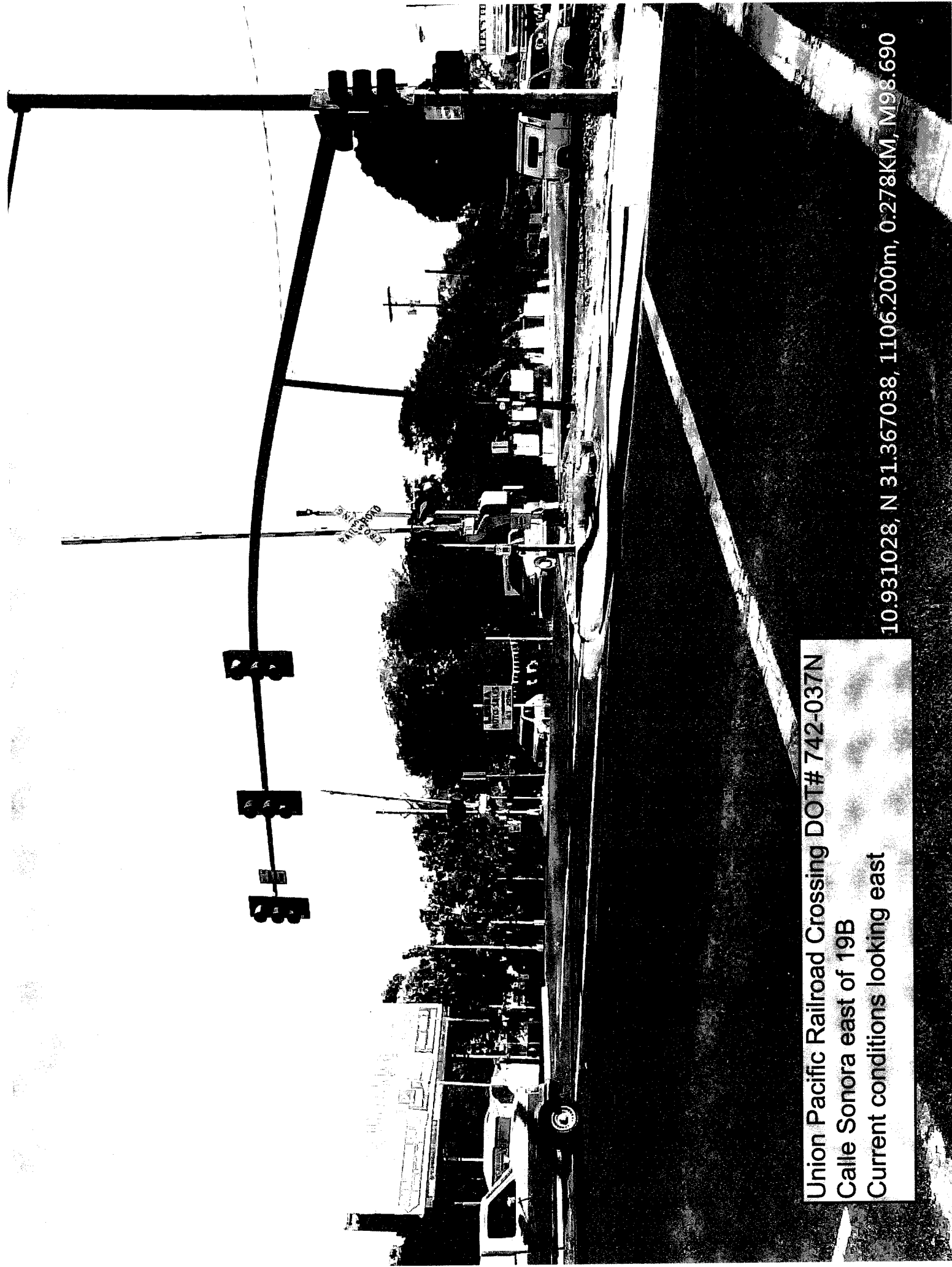




Union Pacific Railroad Crossing DOT# 742-037N

Calle Sonora east of 19B

W -110 Current conditions looking south

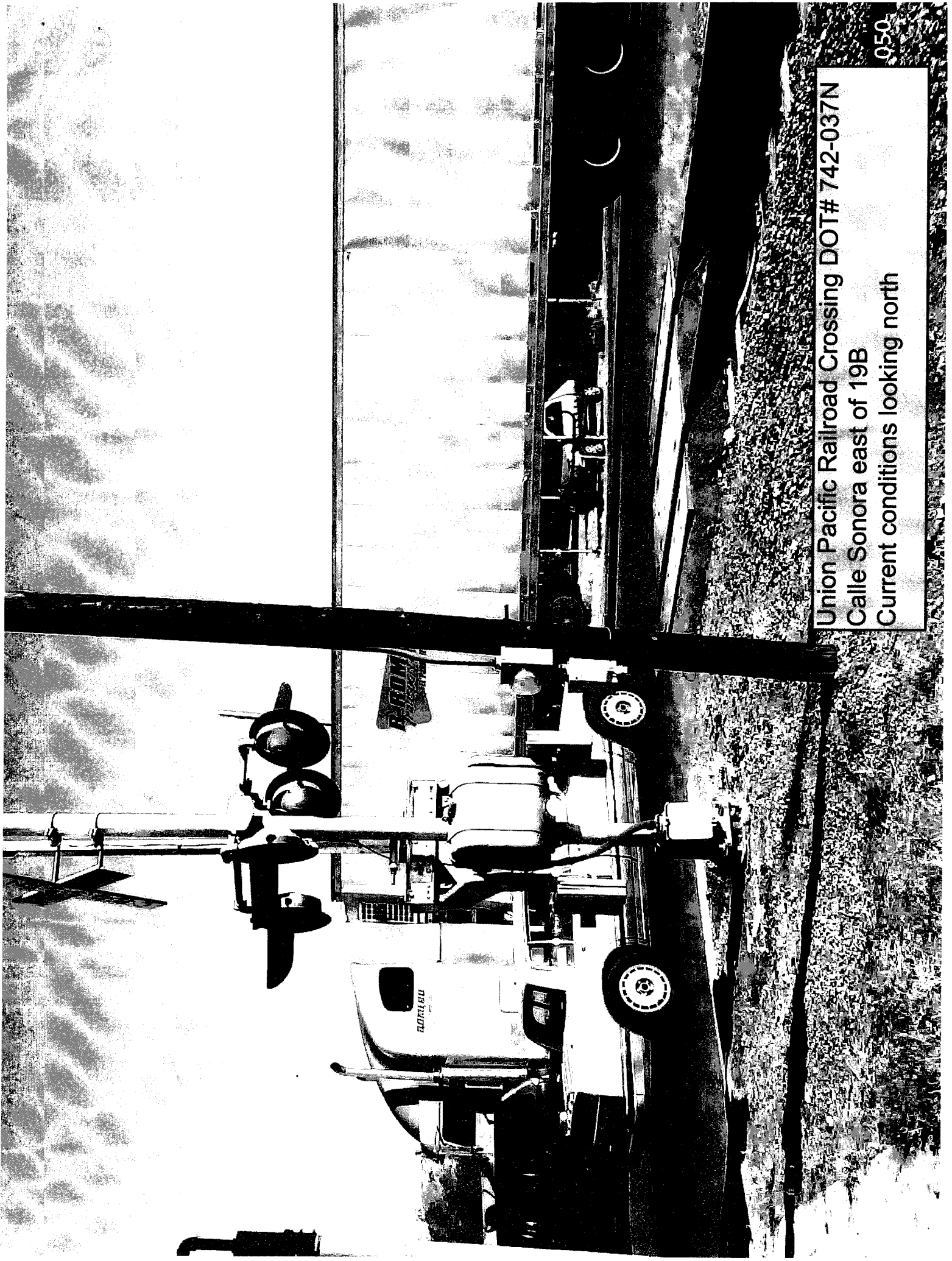


Union Pacific Railroad Crossing DOT# 742-037N

Calle Sonora east of 19B

Current conditions looking east

10.931028, N 31.367038, 1106.200m, 0.278KM, M98.690



Union Pacific Railroad Crossing DOT# 742-037N  
Calle Sonora east of 19B  
Current conditions looking north



Intermodal Transportation

Douglas A. Ducey, Governor  
John S. Halikowski, Director  
Dallas Hammit, State Engineer  
Steve Boschen, Division Director

August 31, 2015

## **RAILROAD CROSSING PROJECT**

TRACS No.: 0000 SW VAR SR214 01X

Project No.: SLP-0(201)P

Location: Calle Sonora, east of SR 19B in Nogales, Arizona

DOT No.: 742-037N

RRMP: 62.83 Nogales Subdivision

Agreement No: 3582-15-UPRR(1532)

### **RAILROAD AGREEMENT**

**For**

**FEDERAL AID**

**Railroad Crossing Projects**

**THE UNION PACIFIC RAILROAD COMPANY**

**Agreement No. 3582-15-UPRR(1532)**

**RAIL/HIGHWAY SAFETY PROGRAM**

**EXHIBIT A**  
**Agreement 3582-15-UPRR(1532)**  
**TRACS No. 0000 SW VAR SR214 01X**  
**PROJECT SLP-0(201)P**

SUMMARY OF ESTIMATE

**Construction:**

**Calle Sonora Signal**

Labor	\$166,773.00
<u>Material</u>	<u>\$199,541.00</u>
Signal Subtotal	\$366,314.00

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Total	*\$366,314.00
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\* Railroad will invoice ADOT for 100% of total work.  
Railroad will separate Preliminary Engineering costs  
from Construction costs. Costs include installation of  
signals.



**Calle  
Sonora @  
UPRR  
742-037N**

Page 3 of 17

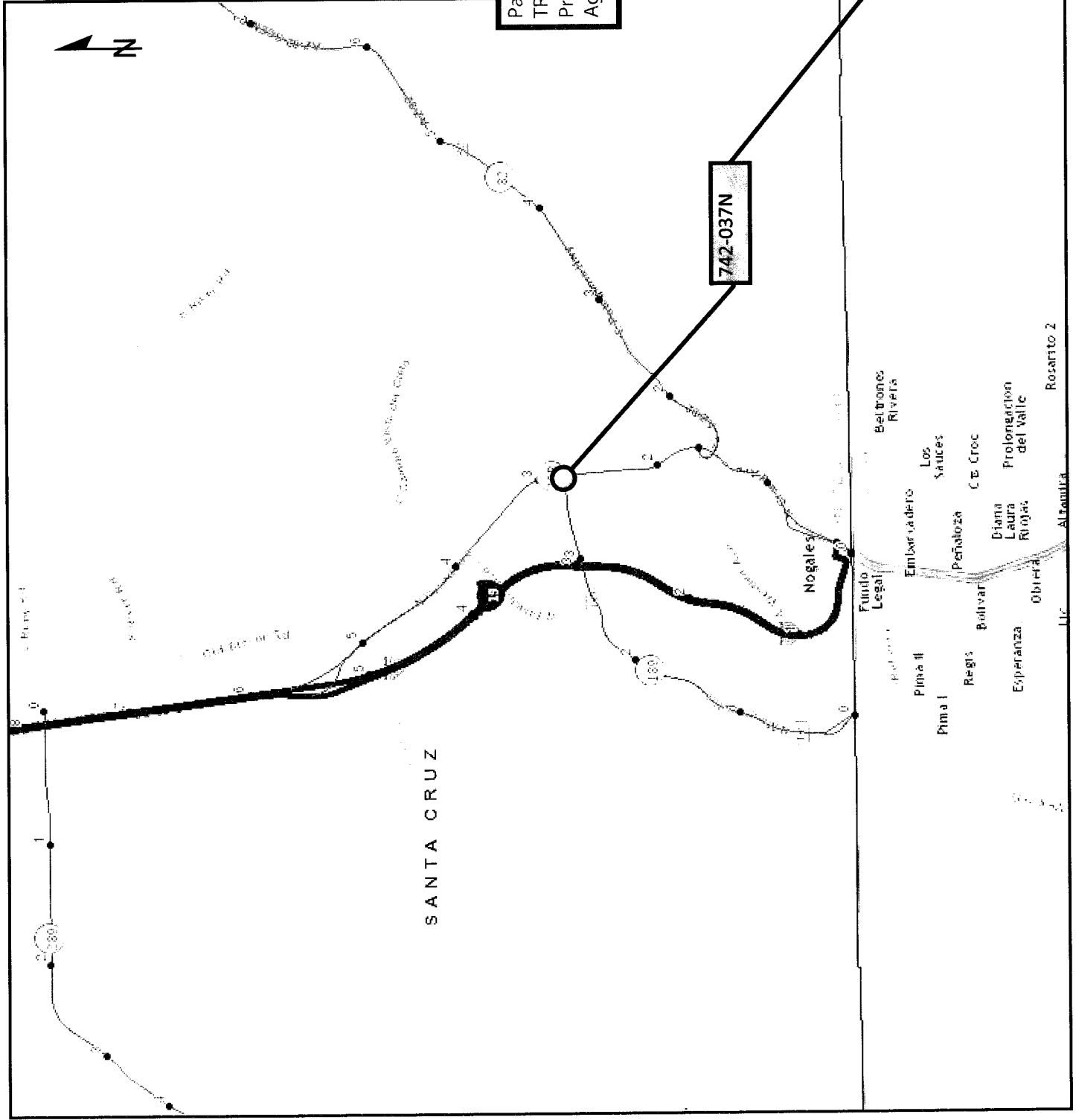
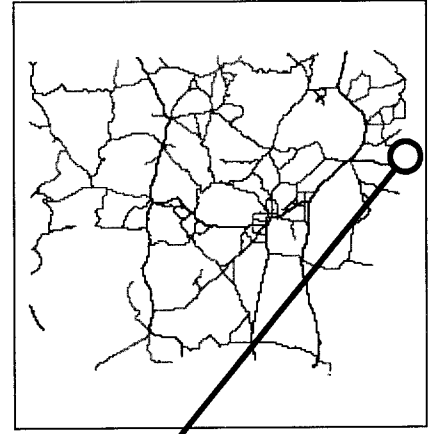
TRACS No.: 0000 SW VAR SR214 01X

Project No.: SLP-0(201)P

Agreement No: 3582-15-UPRR(1532)



1:72,224



DATE: 2015-07-28

ESTIMATE OF MATERIAL AND FORCE ACCOUNT WORK  
BY THE  
UNION PACIFIC RAILROAD

THIS ESTIMATE GOOD FOR 6 MONTHS EXPIRATION DATE IS :2016-01-26

## DESCRIPTION OF WORK:

INSTALL AUTOMATIC FLASHING LIGHT CROSSING SIGNALS  
WITH GATES AT NOGALES, AZ. CALLE SONORA M.P. 62.83  
ON THE NOGALES SUB. DOT #742037N

WORK TO BE PERFORMED BY RAILROAD WITH EXPENSE AS BELOW:

SIGNAL/TRACK - AZDOT - 100%

ESTIMATED USING FEDERAL ADDITIVES-SIGNAL 119.82% &amp; TRACK 166.85%

PID: 89137 AWO: 27035 MP,SUBDIV: 62.83, NOGALES  
SERVICE UNIT: 16 CITY: CALABASAS STATE: AZ

DESCRIPTION	QTY	UNIT	LABOR	MATERIAL	RECOLL	UPRR	TOTAL
<b>ENGINEERING WORK</b>							
ENGINEERING			6869		6869		6869
LABOR ADDITIVE 119.82%			13911		13911		13911
SIG-HWY XNG			4821		4821		4821
<b>TOTAL ENGINEERING</b>			<b>25601</b>		<b>25601</b>		<b>25601</b>
<b>SIGNAL WORK</b>							
BILL PREP			900		900		900
CONTRACT				10077	10077		10077
LABOR ADDITIVE 119.82%			73941		73941		73941
MATL STORE EXPENSE				20	20		20
METER SERVICE				30000	30000		30000
PERSONAL EXPENSES				27372	27372		27372
RCLW CONTRACT				8376	8376		8376
ROCK/GRAVEL/FILL				8000	8000		8000
SALES TAX				4031	4031		4031
SIGNAL			60810	100776	161586		161586
TRANSP/IB/OB/RCLW				7326	7326		7326
<b>TOTAL SIGNAL</b>			<b>135651</b>	<b>195978</b>	<b>331629</b>		<b>331629</b>
<b>TRACK &amp; SURFACE WORK</b>							
ENVIRONMENTAL - PERMITS				10	10		10
FIELD WELD			132		132		132
LABOR ADDITIVE 166.85%			2703		2703		2703
MATL STORE EXPENSE				162	162		162
OTM			2675	3006	5681		5681
SALES TAX				130	130		130
WELD			11	255	266		266
<b>TOTAL TRACK &amp; SURFACE</b>			<b>5521</b>	<b>3563</b>	<b>9084</b>		<b>9084</b>
<b>LABOR/MATERIAL EXPENSE</b>			<b>166773</b>	<b>199541</b>			
<b>RECOLLECTIBLE/UPRR EXPENSE</b>					<b>366314</b>	<b>0</b>	
<b>ESTIMATED PROJECT COST</b>							<b>366314</b>

THE ABOVE FIGURES ARE ESTIMATES ONLY AND SUBJECT TO FLUCTUATION. IN THE EVENT OF AN INCREASE OR DECREASE IN THE COST OR QUANTITY OF MATERIAL OR LABOR REQUIRED, UPRR WILL BILL FOR ACTUAL CONSTRUCTION COSTS AT THE CURRENT EFFECTIVE RATE.

Page 4 of 17

TRACS No.: 0000 SW VAR SR214 01X

Project No.: SLP-0(201)P

Agreement No: 3582-15-UPRR(1532)





**RAILROAD ORIGINAL**

**STATE OF ARIZONA  
DEPARTMENT OF TRANSPORTATION**

Agreement No. 1532-91-SPTC

Agreement Addendum No. 2

Original Agreement AG Contract # KR92-1689-TRN

Railroad's Name The Union Pacific Railroad  
Address 101 S. Watson Road, Arlington, TX 76010

COMPANY hereby agrees to modify the existing referenced Agreement and to do the work hereinafter set forth for the AGENCY in accordance with the original agreement, the modified provisions of this form and of the attached sheets, if any, and COMPANY agrees to receive and accept as full compensation therefore the payment provided in the agreement as modified herein.

WHEREAS: STATE and RAILROAD agree to revise original Agreement to include the current "BUY AMERICA" requirements of 23 CFR 635.410

THEREFORE: The parties hereto agree that Agreement No. 1531-91-ATSF is hereby amended to include the following: All portions of the Project whether performed by the State or Company shall be performed in compliance with 23 CFR 635.410 and 23 USC 313 as amended by Section 1518 of P.L. 112-141 Buy America Requirements. Company shall maintain documentation/certification of all products of iron, steel, or a coating of steel that are incorporated into the Project for a period of three years after completion of all obligations under this Agreement. Within a reasonable time after State's written request, Company shall make such records available for State's audit during Company's regular business hours in Company's headquarters office located in Omaha Nebraska.

The RAILROAD hereby agrees to the terms as above set forth, provided that by mutual consent this agreement may be modified or terminated at any time.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement.

ARIZONA DEPARTMENT OF TRANSPORTATION

UNION PACIFIC RAILROAD COMPANY

By Victoria D. Bever  
Victoria D. Bever, Manager  
Utility & Railroad Engineering Section

By John J. Hovanec  
John J. Hovanec  
Title: AVP Engineering

Date 03/06/2015

Date 2/21/2015

STATE OF ARIZONA  
DEPARTMENT OF TRANSPORTATION

Agreement No. 1532-91-SPTC

Agreement Addendum No. 1

Company's Name: The Union Pacific Railroad Company  
Address: 101 S. Watson Road, Arlington, TX 76010

The purpose of this addendum is to modify the Company name as stated herein:

WHEREAS: Agreement No. 1532-91-SPTC terms the "RAILROAD" as SOUTHERN PACIFIC TRANSPORTATION COMPANY.

WHEREAS: Agreement No. 1532-91-SPTC is revised to term the "RAILROAD" as the UNION PACIFIC RAILROAD COMPANY.

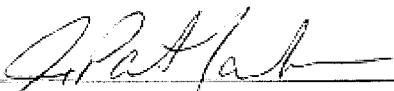
THEREFORE: The parties hereto agree that Agreement No. 1532-91-SPTC is hereby amended as shown herein. All other provisions of Agreement No. 1532-91-SPTC shall remain unabrogated.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement.

ARIZONA DEPARTMENT OF TRANSPORTATION

UNION PACIFIC RAILROAD COMPANY

By



WILLIAM R. BRISCOE, P.E.

Utility & Railroad Engineering Section

Date

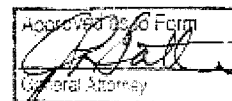
2-18-99

By



CHIEF ENGINEER

Date



A. G. CONTRACT NO. KR95-1689-TF

ARIZONA DEPARTMENT OF TRANSPORTATION  
HIGHWAYS DIVISION  
UTILITY AND RAILROAD ENGINEERING SECTION

MASTER  
RAILROAD AGREEMENT  
For  
FEDERAL AID  
Railroad Crossing Projects

SOUTHERN PACIFIC TRANSPORTATION COMPANY  
Agreement No. 1532-91-SPTC  
RAIL/HIGHWAY SAFETY PROGRAM

THIS AGREEMENT by and between SOUTHERN PACIFIC TRANSPORTATION COMPANY, a Delaware corporation, herein termed "RAILROAD," and STATE OF ARIZONA, DEPARTMENT OF TRANSPORTATION, HIGHWAYS DIVISION, herein termed "STATE".

WITNESSETH:

The parties hereto desire to set forth by this instrument their understanding and agreements with respect to the installation, at various times, of railroad warning devices and/or surface crossing materials with track rehabilitation, if required, throughout the State of Arizona, where a roadway crosses the property and tracks of RAILROAD.

AGREEMENT:

NOW THEREFORE, it is mutually agreed as follows:

1. The work to be performed by RAILROAD under this agreement is hereinafter referred to as "PROJECT".

2. RAILROAD agrees to furnish all labor, materials, tools, and equipment necessary to install such warning devices including necessary actuating and operating circuits and adequate instrument housing and/or roadway crossing materials with track rehabilitation, if required, upon its property at certain designated grade crossings.

Said installation shall comply with the latest standards prescribed by the Association of American Railroads and the Manual On Uniform Traffic Control Devices, Part VIII.

3. RAILROAD will prepare both a cost estimate, marked Exhibit "A" and a location plan marked, Exhibit "B", showing the general details of each PROJECT and send them to STATE for acceptance.

4. It is agreed that the work to be performed by RAILROAD is a part of a Federal-Aid project. Pursuant to the provisions of Federal-Aid Policy Guide Subchapter G, Part 646 Subpart B, there is no ascertainable net benefit to RAILROAD, and STATE agrees to reimburse RAILROAD for one hundred percent (100%) of the cost and expense incurred by RAILROAD in furnishing of materials and performing the work as described in the Cost Estimate, marked EXHIBIT "A", attached to and made a part hereof.

5. It is understood and agreed that the STATE is acting solely as an agent for the project sponsor in securing and administering Federal funds and STATE assumes no other liability hereunder for the project sponsor.

6. Prior to commencing construction of each PROJECT, Railroad agrees to notify STATE, in writing, of the actual construction start date. Upon completion of each PROJECT, RAILROAD agrees to notify STATE, in writing, of the actual completion date. The construction start date shall not be prior to receiving a notice to proceed from STATE. Construction progress payments shall not be made without the actual construction start date. Final payment shall not be made without the actual construction completion date.

7. The work for each PROJECT shall be performed by RAILROAD forces on an actual cost basis, and as supported by the analysis of estimated costs set forth in Exhibit "A". The actual cost shall be payable in payments as follows:

- a. RAILROAD will order the materials for each PROJECT, and may invoice the STATE upon receipt, for materials and related costs, as set forth in Exhibit "A".
- b. RAILROAD may submit monthly invoices for work performed and materials installed unless invoiced under subparagraph a.
- c. Minimum payment, except for final invoice, is \$5,000.
- d. Upon completion of all work under each PROJECT, RAILROAD shall arrange for a joint close-out inspection of the completed PROJECT. Upon determination by STATE that the work has been completed in accordance

with Exhibits "A" and "B", RAILROAD will submit final and complete invoice to the STATE. STATE agrees to pay RAILROAD the difference between the final invoice and any previous payments for PROJECT. Any amount with which STATE disagrees shall be paid under protest, subject to resolution.

- e. All invoices will be paid by STATE within sixty (60) days of receipt.

All expenses incurred by RAILROAD for work which STATE is obligated to reimburse RAILROAD hereunder, including all work incidental to such work but not specifically mentioned herein, shall be subject to the provisions of the Federal-Aid Policy Guide Subchapter B Part 140 Subpart I.

8. Pursuant to A.R.S. Sections 35-214, 35-215 and 41-1279.04, the books of RAILROAD shall be open for inspection and audit by authorized representatives of STATE and the Federal Government for a period of not less than five (5) years from the date final payment has been received by RAILROAD. State agrees to pay RAILROAD any sums found to be owing as a result of an audit within sixty (60) days of receipt of the audit by the Utility and Railroad Engineering Section of STATE. RAILROAD agrees to reimburse STATE, within sixty (60) days of notification for any amount STATE disallows as a result of its audit. Any audit exceptions with which RAILROAD disagrees shall be paid to STATE under protest subject to resolution.

9. All invoices shall contain STATE's project number and agreement number. The invoice shall be sent to:

ARIZONA DEPARTMENT OF TRANSPORTATION  
Utility and Railroad Engineering Section  
205 South 17th Ave. Mail Drop 618E  
Phoenix, Arizona 85007-3212

10. Once installation of railroad warning devices and/or roadway crossing material has been completed, RAILROAD shall maintain, in kind, the railroad warning devices and the crossing material two feet outside of each rail as long as they remain in place. However, RAILROAD shall be entitled to receive any contribution toward the cost of such maintenance as may be now or hereafter made available by means of any law, ordinance, regulation, order, grant or by other means or sources.

11. Claims and disputes between STATE and RAILROAD involving sums less than \$100,000 and arising out of the terms of this Agreement relating to work performed, invoicing and similar matters, shall be subject to arbitration, at the request of either party, in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association then obtaining; provided, however, that claims or disputes arising out of personal injury, death, property damage, or environmental incidents shall not be subject to arbitration without the concurrence of both parties, except to the extent otherwise required by the rules of Arizona courts.

12. In compliance with the regulations of the United States Department of Transportation, RAILROAD hereby agrees to comply fully with all of the provisions of Appendix "A", attached hereto and by this reference made a part of this Agreement; provided, however, that Appendix "A" shall be applicable only in those cases where RAILROAD does not perform the work contemplated in this Agreement with its own forces.

13. This Agreement is subject to the budgetary limitations set forth in Arizona Revised Statutes Subsection 28-1823 through 28-1826 inclusive and is further subject to the provisions of Chapter 1 of Title 35, Arizona Revised Statutes.

14. STATE and RAILROAD each agrees to be liable to the other party for its own acts of negligence and the negligence of its own employees.

15. This Agreement shall inure to the benefit of and be binding upon the successors and assigns of RAILROAD and the assigns of STATE.

16. RAILROAD is required to comply with Executive Order 75-5, "Non-Discrimination in Employment by Government Contractors and Subcontractors," which is hereby included in its entirety by reference and considered a part of this Agreement.

17. Pursuant to A.R.S. Subsection 38-511, STATE may cancel this Agreement, without penalty or further obligation, if any person significantly involved in initiating, negotiating, securing, drafting or creating the Agreement on behalf of STATE or any of its departments or agencies is, at any time while this Agreement or any extension of it is in effect, an employee of any other party to this Agreement with respect to the subject matter of this Agreement.

:  
:  
:  
:  
:



IN WITNESS WHEREOF, the parties have executed this Agreement as of the day and year signed by both parties.

SOUTHERN PACIFIC  
TRANSPORTATION COMPANY

ARIZONA DEPART. OF TRANSPORTATION  
HIGHWAY DIVISION

By  
Its

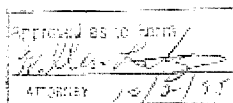
John L. Madson  
MANAGER-CONTRACTS

By

William R. Briscoe  
Manager of Utility & Railroad  
Engineering Section

Date October 2, 1995

Date 10-17-95



STATE OF COLORADO       )  
  ) ss.  
COUNTY of DENVER       )

The foregoing instrument was acknowledged before me this 2nd day of October, 1995, by Ms. J. L. Madson, the MANAGER-CONTRACTS of SOUTHERN PACIFIC TRANSPORTATION COMPANY, a Delaware corporation, on behalf of the corporation.

My Commission Expires  
2-11-97

Notary Public

Alison Dilges

My Commission Expires 2-11-97

STATE OF ARIZONA       )  
  ) ss.  
COUNTY of MARICOPA    )

The foregoing instrument was acknowledged before me this 17 day of October, 1995, by William R. Briscoe, the Manager of Utility and Railroad Engineering Section of the Arizona Department of Transportation, on behalf of the STATE.

My Commission Expires:

2-11-97

Notary Public

Carrie Marie

APPENDIX A  
(Revised)

II EQUAL OPPORTUNITY

1. Selection of Labor:

During the performance of this contract, the contractor shall not discriminate against labor from any other State, possession or territory of the United States.

2. Employment Practices:

During the performance of this contract, the contractor agrees as follows:

a. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoffs or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the State highway department setting forth the provisions of this nondiscrimination clause.

b. The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

c. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided by the State highway department advising the said labor union or workers' representative of the contractors commitments under this section II-2 and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

d. The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations (41 CFR, Part 60) and relevant orders of the Secretary of Labor.

e. The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records and accounts by the Federal Highway Administration and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations and orders.

f. In the event of the contractor's noncompliance with the non-discrimination clauses of this contract or with any of the said rules, regulations or orders, this contract may be canceled, terminated or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts or Federally-assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation or order of the Secretary of Labor, or as otherwise provided by law.

g. The contractor will include the provisions of this Section 11-2 in every subcontract or purchase order unless exempted by rules, regulations or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the State highway department or the Federal Highway Administration may direct as a means of enforcing such provisions including sanctions for noncompliance: Provided, however, that in the event a contractor becomes involved in, or is threatened with litigation with a subcontractor or vendor as a result of such direction by the Federal Highway Administration, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

3. Selection of Subcontractors, Procurement of Materials, and Leasing of Equipment:

During the performance of this contract, the contractor, for itself, its assigns and successors in interest (hereinafter referred to as the "contractor") agrees as follows:

a. Compliance With Regulations: The contractor shall comply with the Regulations relative to nondiscrimination in federally-assisted programs of the Department of Transportation, Title 49, Code of Federal Regulations, Part 21, as they may be amended from time to time, (hereinafter referred to as the Regulations), which are herein incorporated by reference and made a part of this contract.

b. Nondiscrimination: The contractor, with regard to the work performed by it during the contract, shall not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The contractor shall not participate either directly or indirectly in the discrimination prohibited by section 21.5 of the Regulations, including employment practices when the contract covers a program set forth in Appendix B of the Regulations.

c. Solicitations for Subcontracts, Including Procurements of Materials and Equipment: In all solicitations either by competitive bidding or negotiation made by the contractor for work to be performed under a subcontract, including procurements of materials or leases of equipment, each potential subcontractor or supplier shall be notified by the contractor of the contractor's obligations under this contract and the Regulations relative to nondiscrimination on the grounds of race, color, or national origin.

d. Information and Reports: The contractor shall provide all information and reports required by the Regulations, or directives issued pursuant thereto, and shall permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the State highway department or the Federal Highway Administration to be pertinent to ascertain compliance with such Regulations or directives. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish this information the contractor shall so certify to the State highway department, or the Federal Highway Administration as appropriate, and shall set forth what efforts it has made to obtain the information.

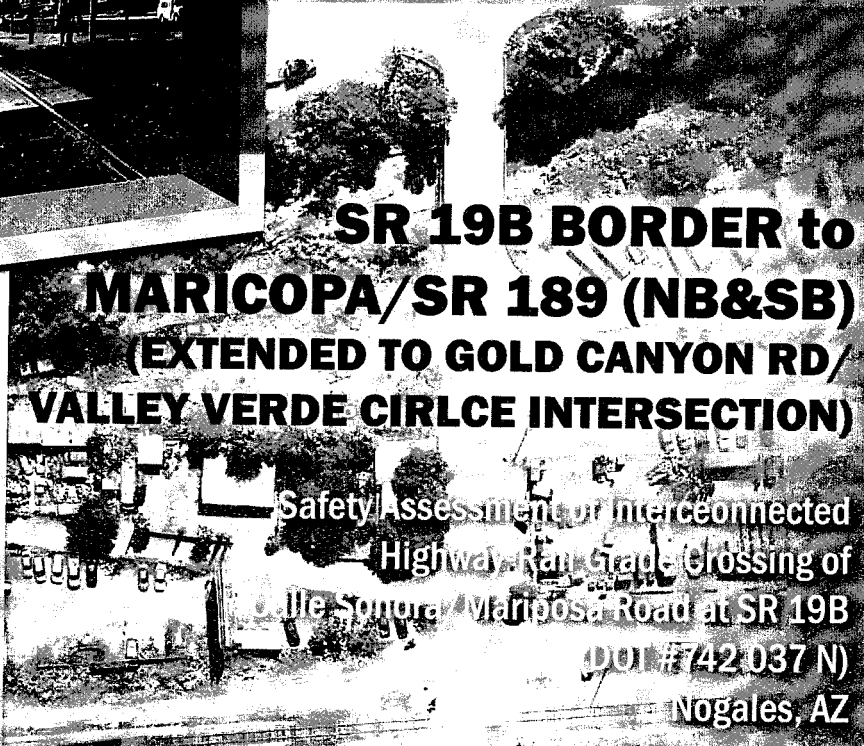
e. Sanctions for Noncompliance: In the event of the contractor's noncompliance with the nondiscrimination provisions of this contract, the State highway department shall impose such contract sanctions as it or the Federal Highway Administration may determine to be appropriate, including, but not limited to:

- (1) withholding of payments to the contractor under the contract until the contractor complies, and/or
- (2) cancellation, termination or suspension of the contract, in whole or in part.

f. Incorporation of Provisions: The contractor shall include the provision of this paragraph 3 in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Regulations, or directives issued pursuant thereto. The contractor shall take such action with respect to any subcontractor or procurement as the State highway department or the Federal Highway Administration may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, however, that, in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or supplier as a result of such direction, the contractor may request the State highway department to enter into such litigation to protect the interests of the State, and, in addition, the contractor may request the United States to enter into such litigation to protect the interests of the United States.



# Baker



## **SR 19B BORDER to MARICOPA/SR 189 (NB&SB) (EXTENDED TO GOLD CANYON RD/ VALLEY VERDE CIRLCE INTERSECTION)**

Safety Assessment of Interconnected  
Highway-Rail Grade Crossing of  
Elle Sonora / Maricopa Road at SR 19B  
(DOI #742 037 N)  
Nogales, AZ

**DRAFT FINAL REPORT**  
May 2014

Prepared for:

**ADOT**



## Table of Contents

1.0	Executive Summary.....	1
2.0	Introduction .....	3
3.0	Existing Conditions .....	8
4.0	Existing Traffic Signal and Railroad Preemption Operation.....	12
5.0	Preemption Operation Test Results.....	14
6.0	Recommendations .....	15

## List of Figures

Figure 1: Vicinity and Location Map .....	9
Figure 2: Site Specific Grade Crossing Information.....	11
Figure 3: Traffic Signal Controller .....	12

## List of Tables

Table 1: Existing Signing and Pavement Markings.....	10
Table 2: Summary of Traffic Signal Operation .....	12
Table 3: Summary of Railroad Preemption Operation .....	13
Table 4: Existing Right-of-Way Transfer Time Calculation.....	13
Table 5: Preemption Operation Test Results.....	14
Table 6: Recommended Improvements Cost Estimate .....	20

## Appendices

- Appendix A: Federal Railroad Administration Accident Prediction Report
- Appendix B: Existing Traffic Signal Plans and Signal Timing
- Appendix C: Preemption Timing Calculation Worksheet



## 1.0 Executive Summary

Michael Baker Jr., Inc. (Baker) was retained by Arizona Department of Transportation (ADOT) to perform a safety assessment of the interconnected highway-rail grade crossing on Calle Sonora (DOT# 742 037 N) at Nogales Business Route (SR 19B) in Nogales, Arizona. The safety assessment included a comprehensive inventory and review of the Union Pacific Railroad (UPRR) grade crossing's existing signal equipment, railroad equipment and intersection elements such as pedestrian and vehicular signal heads, cabinets, controller hardware, pull boxes, railroad automatic gates, railroad bungalow, signage and pavement markings for consistency with current State and National standards. The safety assessment also included the inspection of the interconnected signals operation.

Based on the specific features of the traffic control devices and operation of the interconnected signals reviewed at the Calle Sonora highway-rail grade crossing for consistency with current industry practice, the following proposed recommendations are being presented to ADOT for consideration to enhance the operation of the preemption system. The proposed recommendations are separated into three categories: Short Term, Mid Term and Long Term based upon a projected implementation time.

### Short Term Improvements:

- Preemption Operation Improvements
  - It is recommended that the track clearance green time be increased from 5 seconds to 59 seconds.
- Site Improvements per 2009 MUTCD compliance
  - It is recommended that ADOT install additional Grade Crossing Advance Warning signs in advance of the grade crossing along Mariposa Road and SR 19B;
  - It is recommended that ADOT install a STOP HERE ON RED (R10-6a) sign;
  - It is recommended that Grade Crossing Pavement Markings be installed along Calle Sonora in advance of the grade crossing;
  - It is recommended that the stop line located west of the automatic gates be removed and a new stop line be installed prior to the automatic gates to indicate the point behind which roadway users are required to stop when the railroad automatic gates are activated; and
  - It is recommended that all crosswalk and stop line pavement markings along SR 19B and all striping along Calle Sonora 205 feet from the intersection be refreshed.

### Mid Term Recommended Improvements:

- Preemption Operation Improvement
  - Advance preemption is recommended to be implemented at this location with 44 seconds of additional warning time required from the railroad;
  - It is recommended that new interconnect conduit be installed from the traffic signal controller cabinet to the railroad equipment housing;
  - It is recommended that a maximum preemption timer circuit be provided for the traffic control signal;



Safety Assessment of Interconnected  
Highway-Rail Grade Crossing  
Draft Final Report

- It is recommended that a gate down circuit be installed at this highway-rail crossing;
  - It is recommended that a traffic signal health circuit be installed at this highway-rail crossing;
  - ADOT and UPRR should jointly develop an agreement to provide a maintenance program; and
  - It is recommended that ADOT develop procedures to handle equipment failure and/or lane closures.
- Traffic Signal Operation Improvements
  - It is recommended that the existing northbound to eastbound right-turn movement be restricted during preemption by installing a NO RIGHT TURN blank-out sign on the signal pole on the southeast corner and on the signal pole on the northeast corner;
  - It is recommended that a battery back-up system be provided for the traffic control signal.

Long Term Recommended Improvements:

- Traffic Signal Operation Improvements
  - It is recommended that this highway-rail crossing be analyzed to determine if queuing vehicles extend into the track area and pre-signals should be installed.
- Site Improvements
  - It is recommended that an engineering study be completed to determine if better nighttime visibility of trains and a highway-railroad grade crossing is needed; and
  - Because of the variety of factors that may contribute to pedestrian hazards, a detailed study is recommended to determine the most effective measures to provide for pedestrian safety at this location when pedestrian and bicyclist facilities are constructed.

Improvements to be completed by the railroad:

- Raise existing equipment housing foundation to alleviate flooding issues; and
- Installing new interconnect conductors from the traffic signal controller to the railroad equipment housing.





## 2.0 Introduction

Michael Baker Jr., Inc. (Baker) was retained by Arizona Department of Transportation (ADOT) to perform a safety assessment of the interconnected highway-rail grade crossing on Calle Sonora (DOT# 742 037 N) at Nogales Business Route (SR 19B) in Nogales, Arizona. The safety assessment included a comprehensive inventory and review of the Union Pacific Railroad (UPRR) grade crossing's existing signal equipment, railroad equipment and intersection elements such as pedestrian and vehicular signal heads, cabinets, controller hardware, pull boxes, railroad automatic gates, railroad bungalow, signage and pavement markings for consistency with current State and National standards. The safety assessment also included the inspection of the interconnected signals operation.

### 2.1 Background

ADOT is in the process of updating and working with the UPRR and BNSF in the state to change the existing railroad crossings that are operating in simultaneous preemption to advance preemption. A pavement preservation project is programmed for SR 19B from the border to Calle Sonora/Mariposa Road (SR 189) to maintain pavement structural integrity and improve the ride and safety of the highway. Three of the six crossings currently operating in simultaneous preemption fall within the pavement preservation project limits. Therefore, it was determined to include these three crossings at Banks Bridge, Dos Street and Calle Sonora as well as the three crossings outside of the pavement preservation limits (Baffert Road, Produce Road and Gold Hill Road) to upgrade railroad preemption operation, traffic signal operation and signing and marking to 2009 MUTCD standards to increase safety.

### 2.2 Diagnostic Meeting

On Thursday, November 29, 2012, a diagnostic meeting was conducted to inventory existing conditions at the UPRR grade crossing on Calle Sonora (DOT# 742 037 N) and to reach a consensus among the agencies present as to what improvements are needed at the intersection to improve safety, to meet 2009 MUTCD requirements and update traffic signal and railroad signal equipment. The multi-disciplinary team was led by Robert Travis, the ADOT railroad liaison and included representatives from:

- ADOT;
- Union Pacific Railroad (UPRR);
- Federal Highway Administration (FHWA);
- City of Nogales;
- Baker;
- Campbell Technology Corporation (CTC); and
- HDR, Inc.

### 2.3 Joint Field Inspection

On Wednesday, June 26, 2013, a joint field inspection of the traffic signal preemption system interconnected with the UPRR grade crossing on Calle Sonora was conducted on the preemption systems. The following individuals participated in the joint field inspection:

- Jesus Valdez Jr., ADOT signals operations;



- Tom Meyer, UPRR; and
- BriAnne Turpin, Baker.

The purpose of the inspection was to document whether the existing preemption system is operating in accordance with the current design parameters.

## 2.4 Purpose and Objective

The purpose of this study is to document existing conditions of the intersection of SR 19B and Mariposa Road (SR 189)/Calle Sonora and the railroad crossing, to identify any deficiencies and to recommend improvements.

As part of the diagnostic meeting in November 2012 and the joint field inspection in June 2013, data was collected at the site to be used to review the operation of the existing system and to prepare recommendations for potential improvements to the system. The objective of this study is provide information to assist ADOT in making improvements to the design and operation of the preemption system and traffic signal, thus ultimately increasing the safety at this highway-railroad grade crossing.

## 2.6 References Listed in the Report

This report makes reference to the following:

- FHWA's 2009 Manual on Uniform Traffic Control Devices (MUTCD);
- Transportation Research Board (TRB) 1996 *Traffic Signal Operations Near Highway-Rail Grade Crossings*;
- FHWA's "Railroad-Highway Grade Crossing Handbook – Revised Second Edition August 2007 Appendix I Preemption Calculation Procedures, Examples from State of Texas";
- ADOT Traffic Engineering Policies, Guides and Procedures (PGP) Chapter 600 Traffic Signal, last updated January 2012; and
- Arizona Supplement to the 2009 Manual on Uniform Traffic Control Devices.

## 2.7 Definitions Used in this Report

**Advance Preemption** - the notification of an approaching train that is forwarded to the highway traffic signal controller unit (or assembly) by the railroad equipment, in advance of the activation of the railroad warning device.

**Advance Preemption Time (APT)** - the period of time that is the difference between the required maximum highway traffic signal preemption time, and the activation of the railroad warning devices.

**Automatic Gates** - a barrier that is lowered across the roadway when a train is approaching or occupying the crossing.

**Buffer Time (BT)** - time added by the railroad to ensure that the minimum warning time is always provided despite inherent variations in warning times.



Safety Assessment of Interconnected  
Highway-Rail Grade Crossing  
Draft Final Report

**Clear Storage Distance (CSD)** - the distance available for vehicle storage measured from a point six feet from the rail nearest the intersection to the intersection stop line, or the normal stopping point on the highway. At skewed highway-railroad grade crossings and intersections, the six-foot distance should be measured perpendicular to the nearest rail either along the center line or edge line of the highway, as appropriate, to obtain the shorter distance. Where exit gates are used as part of a four-quadrant gate system, the distance available for vehicle storage is measured from the point where the rear of the vehicle would be clear of the exit gate arm. In cases where the exit gate arm is parallel to the track(s) and is not perpendicular to the highway, the distance is measured either along the center line or edge line of the highway, as appropriate, to obtain the shorter distance.

**Design Vehicle Clearance Distance (DVCD)** - the length, in feet, which the design vehicle must travel in order to enter and completely pass through the railroad crossing's minimum track clearance distance (MTCD).

**Diagnostic Team Review/Meeting** - a group of knowledgeable individuals from the Department, road authorities, railroads, and other relevant affected parties who meet and, using highway-railroad grade crossing safety management principles, evaluate conditions at proposed or existing crossings and assist the Department in making determinations concerning safety needs.

**Equipment Housing** - a box, cabinet or bungalow used by a railroad or road authority to shelter any or all of the hardware elements required to control the operation of active traffic control devices or train control systems.

**Federal Railroad Administration (FRA)** - The FRA is part of the United States Department of Transportation. The FRA was created to publicize and enforce rail safety regulations, administer railroad assistance programs, conduct research and development in support of improved railroad safety and national rail transportation policy, provide for the rehabilitation of Northeast Corridor rail passenger service, and consolidate government support of rail transportation activities.

**Flagger** - a qualified railroad employee who is on the ground at a highway-railroad grade crossing to signal to highway users the impending movement of a train or other railroad on-track equipment over the crossing.

**Flashing-Light Signals** - a warning device consisting of two red signals arranged horizontally that are activated to flash alternately when a train is approaching or present at a highway-railroad grade crossing.

**Gate Down Circuit** - notifies the traffic signal controller unit when the gates controlling access over the tracks on the approach to the intersection have either fully lowered or the train has occupied the crossing.

**Highway** - a general term for denoting a public right-of-way for purposes of travel by vehicle, bicycle, pedestrian and/or non-motorized traffic, including the entire area within the right-of-way.



**Highway-Railroad Grade Crossing** - the general area where a highway and a railroad right-of-way cross at the same level. This area includes the railroad tracks, the highway and the traffic control devices for highway traffic traversing that area.

**Interconnection** - the electrical connection between the railroad active warning system and the highway traffic signal controller for the purpose of preemption.

**Manual on Uniform Traffic Control Devices (MUTCD)** - a document that constitutes the prescribed standards of design, construction, and application of traffic control devices for use on the roads.

**Minimum Track Clearance Distance (MTCD)** - the length, in feet, along the highway at one or more railway tracks, measured from the railroad crossing stop line, warning device, or 12 feet perpendicular to the track centerline, whichever is further away from the tracks, to 6 feet beyond the tracks measured perpendicular to the far rail.

**Preemption** - the transfer of normal operation of highway traffic signals to a special control mode.

**Queue Clearance Time (QCT)** - the time required for the design vehicle of maximum length stopped just inside the minimum track clearance distance to start up and move through and clear the entire minimum track clearance distance. If pre-signals are present, this time shall be long enough to allow the vehicle to move through the intersection, or to clear the track if there is sufficient clear storage distance. If a four-quadrant gate system is present, this time shall be long enough to permit the exit gate arm to lower after the design vehicle is clear of the minimum track clearance distance.

**Retroreflective** - a property of a surface that allows a large portion of the light coming from a point source to be returned directly back to a point near its origin.

**Right-of-Way Transfer Time (RWTT)** - the maximum amount of time needed for the worst case condition, prior to display of the track clearance green interval.

**Stop Line** - a solid white pavement marking line extending across approach lanes to indicate the point at which a stop is intended or required to be made by a vehicle.

**Track Clearance Green (TCG) Time/Phase** - Time/Phase to clear the railroad tracks of highway vehicles before a train arrives.

## 2.8 Organization of the Report

This report consists of four additional parts. Subsequent to this introductory chapter:

- Chapter 3 provides a summary of the existing conditions and site specific information for the grade crossing and the intersection.
- Chapter 4 provides a summary of the existing traffic control signal operation and the railroad preemption operation.
- Chapter 5 provides the results of the preemption operation tests conducted during the joint field inspection in June 2013.



Safety Assessment of Interconnected  
Highway-Rail Grade Crossing  
Draft Final Report

- Chapter 6 provides specific recommendations to ADOT for short term, mid-term and long term improvements to the intersection and railroad crossing.



### 3.0 Existing Conditions

The City of Nogales is located at the southern end of Interstate 19 (I-19) at the international border between the United States and Mexico. It is the closest border crossing to the City of Tucson located 70 miles to the north, and the route to the City of Phoenix located approximately 180 miles to the north is entirely via interstate highways, Interstate 10 (I-10) and I-19. There are two Port of Entries (POE) located in the City of Nogales, the Mariposa POE located along State Route 189 (SR 189) and the DeConcini POE/Morley Gate located along SR 19B. The UPRR runs north-south parallel to SR 19B. The highway-rail grade crossing analyzed in this report is located on Calle Sonora, approximately 39 feet east of SR 19B. The intersection of SR 19B and Mariposa Road (SR 189)/Calle Sonora is located 2.8 miles north of the DeConcini POE/Morley Gate. The project Vicinity Map and Location Map are shown in **Figure 1**.



Safety Assessment of Interconnected  
Highway-Rail Grade Crossing  
Draft Final Report

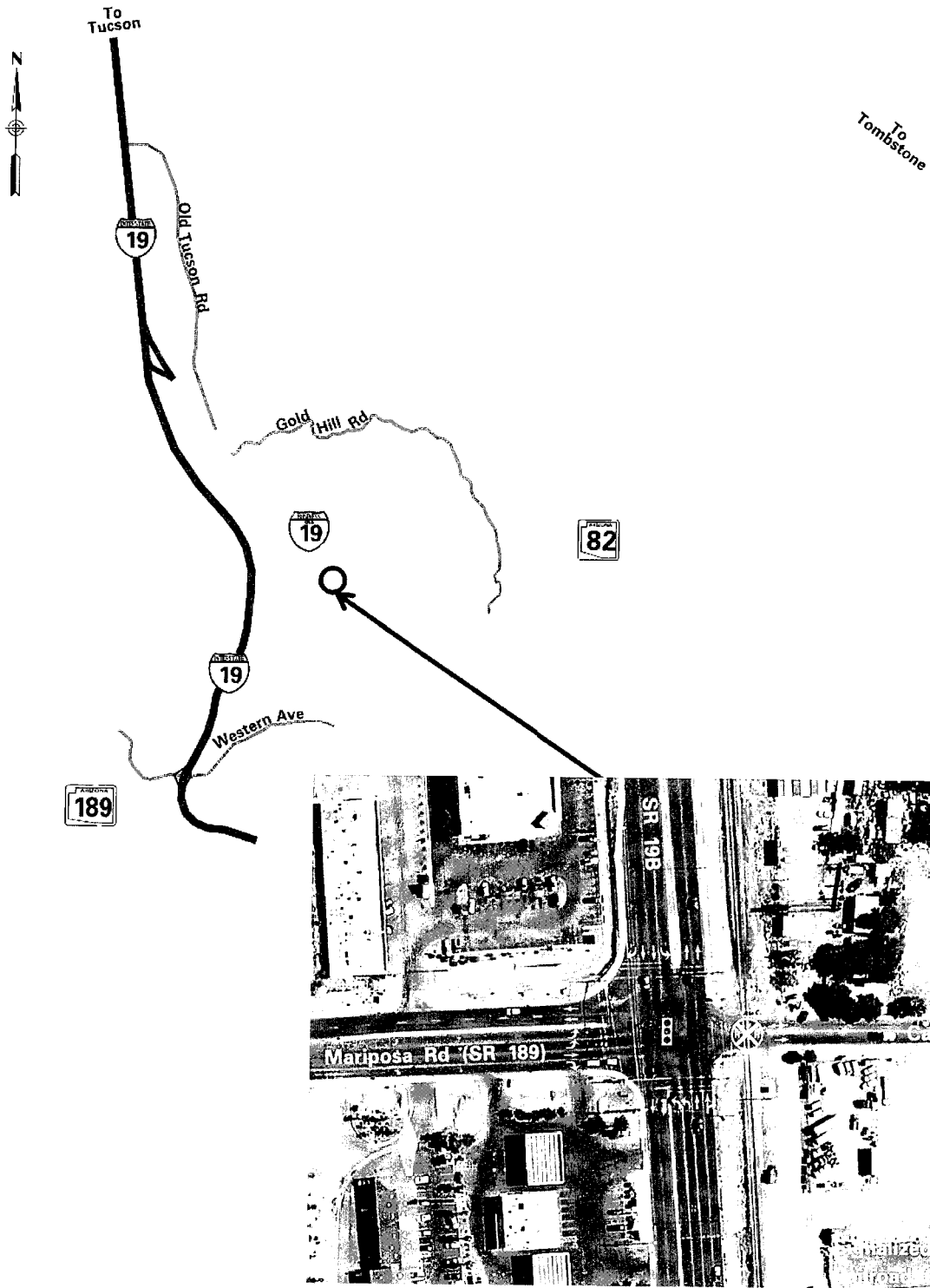


Figure 1. Vicinity and Location Map



### 3.1 Physical Characteristics of the Highway-Rail Crossing

**Mariposa Road (SR 189)/Calle Sonora** is an ADOT owned facility west of SR 19B and is a City of Nogales owned facility east of SR 19B. Mariposa Road (SR 189)/Calle Sonora is classified as an urban principal arterial west of SR 19B and as a local road east of SR 19B, oriented east-west. Mariposa Road (SR 189)/Calle Sonora consists of two lanes in each direction with a two-way left-turn lane and has a speed limit of 40 mph west of SR 19B and one lane in each direction and has a speed limit of 25 mph east of SR 19B. There are sidewalks along Mariposa Road (SR 189), but no sidewalks along Calle Sonora. Mariposa Road (SR 189)/Calle Sonora provides access to industrial, residential and retail developments as well as I-19. The 2012 average annual daily traffic (AADT) along Calle Sonora is 4,027 vehicles per day (vpd). The 2009 AADT along Mariposa Road is 25,000 vpd. There is one shared left-through-right lane in the westbound direction and dual left-turn, one through and one right-turn lane in the eastbound direction at the intersection.

**SR 19B** is an ADOT owned facility that extends from the international border between the United States and Mexico north 5.3 miles to Interstate 19. SR 19B is currently classified as an urban principal arterial roadway, oriented north-south. SR 19B consisting of two lanes in each direction with a two-way left-turn north and south of Mariposa Road (SR 189)/Calle Sonora, but provides a raised median at the intersection. It has a speed limit of 40 mph in the vicinity of Mariposa Road (SR 189)/Calle Sonora. There are sidewalks along SR 19B except along the east side of the south leg. The AADT along SR 19B near Mariposa Road (SR 189)/Calle Sonora is 28,500 vpd. There are dual left-turn lanes, one through lane and one shared through-right lane in the northbound direction and an exclusive left-turn lane, two through lanes and an exclusive right-turn lane in the southbound direction at the intersection.

An inventory of the existing highway-rail grade crossing signing and pavement markings are shown in **Table 1**. The existing pavement markings at the intersection of SR 19B and Calle Sonora are old and have poor retroreflectivity.

Table 1: Existing Signing and Pavement Markings

Feature	NB Approach	SB Approach	EB Approach	WB Approach
DO NOT STOP ON TRACK signs (R8-8)	No	No	No	Yes
Grade Crossing Advance Warning signs (W10-1)	No	No	No	Yes
Turning Restriction or Blank-out signs	No	No	No	No
Grade Crossing Pavement Markings	No	No	No	No
Stop line prior to Railroad Signal Gate	N/A	N/A	N/A	No

There is a DO NOT STOP ON TRACK (R8-8) sign and W10-1 grade crossing advance warning sign east the UPRR tracks. Both signs are for EB traffic. The DO NOT STOP ON TRACK (R8-8) sign is located approximately 11 feet prior to the railroad's automatic gate. The W10-1 grade crossing advance warning sign is located approximately 167 feet prior to the railroad's automatic gate.

UPRR operates on one line track crossing at Calle Sonora adjacent to the signalized intersection at SR 19B.





The Clear Storage Distance (CSD) is 33 feet.

The Minimum Track Clearance Distance (MTCD) is 31 feet.

The roadway grade approaching and over the Minimum Track Clearance Distance (MTCD) is less than 1% and the departing grade is -4%.

**Figure 2** illustrates the location and distance of the CSD, MTCD, design vehicle clearance distance, and queue start-up distance.

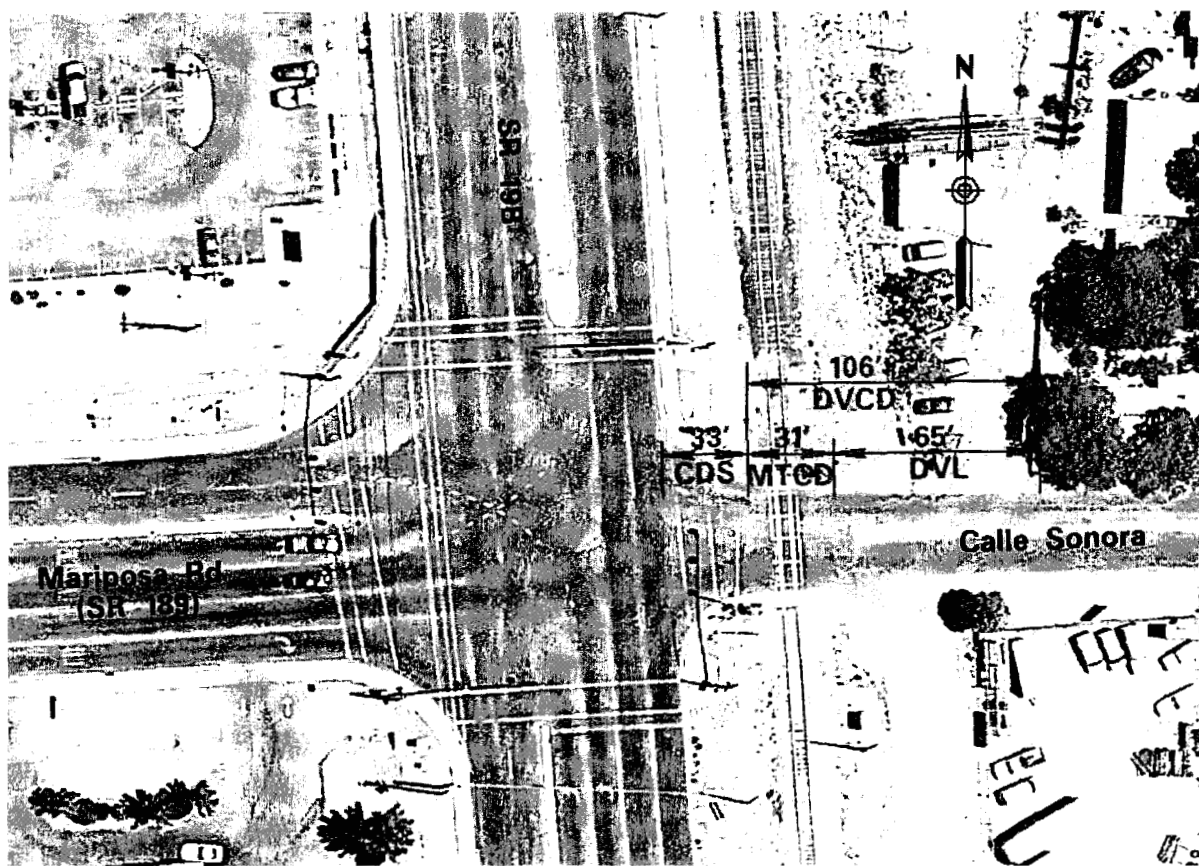


Figure 2: Site Specific Grade Crossing Information

### 3.2 Accident History

Since 2008, there has been no recorded accident between a train and automobile at the Calle Sonora highway-rail grade crossing at the intersection of SR 19B and Mariposa Road (SR 189)/Calle Sonora. As determined by the FRA Web Accident Prediction System, the average number of annual accidents that is predicted to occur within the study area at highway/rail crossings is 0.0119 accidents per year. This number takes into consideration FRA data including: the average daily vehicular traffic that crosses railroad intersections; the average daily train traffic at each crossing, and the history of accidents at each location. The FRA Accident Prediction Report is located in **Appendix A**.



## 4.0 Existing Traffic Signal and Railroad Preemption Operation

### 4.1 Traffic Signal Operation

During the November 2012 diagnostic meeting and June 2013 joint field inspection meeting, information was collected on the existing operation of the traffic signal. The traffic signal controller is an Eagle EPAC 300 with Siemens OS 3.34G firmware installed in the controller unit. The traffic signal controller at the intersection of SR 19B and Mariposa Road (SR 189)/Calle Sonora is shown in **Figure 3**. The traffic signal is coordinated with the intersections along SR 19B from Gold Hill Road/Valley Verde Circle to the north and to Doe Street/Bankard Avenue to the south. The cabinets are not equipped with battery backup units. **Table 2** provides a summary of the information gathered during the diagnostic meeting and the joint field inspection meeting on the existing traffic signal operation. The existing traffic signal plans and signal timings are located in **Appendix B**.

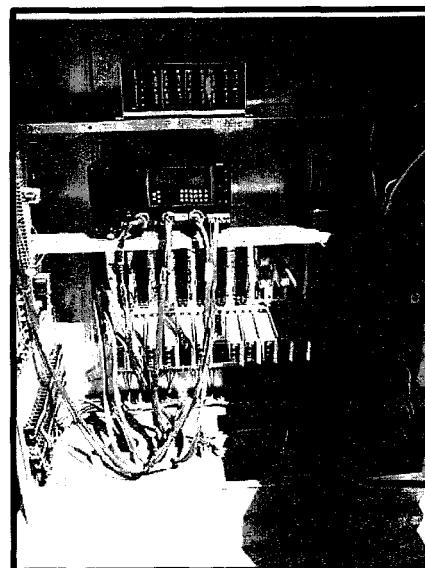


Figure 3: Traffic Signal Controller

Table 2: Summary of Traffic Signal Operation

Description	NB Movement	SB Movement	EB Movement	WB Movement
Vehicle Detection Present?	Loop	Loop	Loop	Loop
Emergency/Malfunction Operation	Yellow Flash	Yellow Flash	Red Flash	Red Flash
<b>Pedestrian Operation</b>				
- Pedestrian Signal Present?	Yes	Yes	Yes	Yes
- Pedestrian Phase	2P	6P	3P	4P
- Crosswalk Length (Feet)	58	99	103	88
- Pedestrian Recall during free operation?	N/A	N/A	N/A	N/A
- Pedestrian Rest-in Walk during free operation?	N/A	N/A	N/A	N/A
- Pedestrian Recall during coordinated operation?	Yes	Yes	No	No
- Pedestrian Rest-in Walk during coordinated operation?	Yes	Yes	No	No
<b>Signal Operation</b>				
- Signal Heads	2-Type R 3-Type F	2-Type R 3-Type F	2-Type R 2-Type F	2-Type Q 3-Type F
- Left-turn movement operation	Protected	Protected	Protected	Protected- Permissive



There are four crosswalks at the intersection. Sidewalk ramps, pedestrian push buttons and pedestrian signal heads are installed on all four corners at the intersection.

## 4.2 Railroad Preemption Operation

Information on the existing railroad preemption operation was collected during the November 2012 diagnostic meeting and June 2013 joint field inspection meeting. **Table 3** provides a summary of the information gathered during the diagnostic meeting and the joint field inspection meeting.

Table 3: Summary of Railroad Preemption Operation

Item	Present	Not Present
Gate Down Circuit		X
Maximum Preemption Time Circuit		X
Traffic Signal Health Circuit		X
Restriction of left-turn movement across tracks during preemption		X
Restriction of right-turn movement across tracks during preemption		X

A two conductor cable is installed for the interconnect circuit. The interconnection is 2-wire single break normally closed. UPRR currently provides constant warning of 20 seconds and 5 seconds of buffer time. The calculated Right-of-Way Transfer Time (RWTT), obtained from the existing preemption timing plans located in **Appendix B**, is 11.9 seconds as shown in **Table 4**.

Table 4: Existing Right-of-Way Transfer Time Calculation

Clearance Timings	Timing Value (sec)
Minimum Green before Track Clearance	5.0
Walk before Track Clearance	5.0
Pedestrian Change before Track Clearance	0.0
Yellow Change before Track Clearance	3.9
Red Clearance before Track Clearance	3.0
<b>Right-of-Way Transfer Time (RWTT)</b>	<b>11.9</b>

The track clearance interval displays a westbound circular green indication at the intersection. The eastbound Mariposa Road movements operate in split phase mode from the westbound Calle Sonora movements. This eliminates a lagging left-turn condition that displays a circular yellow indication for the left-turn movement opposing the track clearance phase during the transfer to the track clearance interval. The traffic signal dwell operation provides limited service operation by cycling through the northbound left, northbound through, southbound through and eastbound left movements and providing a red circular indication for the southbound left, eastbound through and westbound movements during railroad preemption.



## 5.0 Preemption Operation Test Results

When interconnected, the railroad active traffic control device and the traffic control signal operate as one system for the purpose of railroad preemption. Therefore, as part of the June 2013 joint field inspection meeting, the existing preemption system was tested for proper operation in accordance with the current design parameters. The purpose of this test was to verify the proper operation of the preemption system and determine if any operation is incorrect or has been modified from the current design plans. **Table 5** summarizes the preemption operation test results.

Table 5: Preemption Operation Test Results

Operation	Tested	Confirmed	Value Seen in Field
Right-of-Way Transfer Time (RWTT)	X	X	11.9 Seconds
Track Clearance Green (TCG) Phase	X	X	Phase 4
Track Clearance Green (TCG) Time	X	X	6 Seconds*
Preemption Dwell Operation	X	X	

\* This value is not adequate for the track clearance green interval at this location.



## 6.0 Recommendations

As a result of the diagnostic meeting, the joint field inspection meeting, and pre-emption analysis, operational and physical improvements are recommended to be completed at the highway-rail grade crossing and on the adjacent roadways. These recommendations are made in accordance with 2009 MUTCD and the Arizona Supplement to the 2009 MUTCD requirements. The recommended improvements may require a significant period of time in order to complete the design, designate a funding source, procure materials and install the equipment. Therefore, the proposed recommendations are separated into three categories: Short Term, Mid Term and Long Term based upon a projected implementation time.

### 6.1 Short Term Recommended Improvements

#### 6.1.1 Preemption Operation Improvements

##### 6.1.1.1 Track Clearance Green (TCG) Time

The existing track clearance green (TCG) time is programmed for 5 seconds. The existing TCG Time is not long enough to prevent premature display of a red traffic signal for traffic clearing the tracks. It is recommended that the track clearance green time be increased from 5 seconds to 59 seconds.

The minimum amount of TCG time that should be programmed into the traffic signal controller was estimated by setting the TCG to the higher of:

- The queue clearance time; or
- The advance preemption time (APT) plus 15 seconds.

The queue clearance time was calculated to be 19 seconds using Figure 2 and Table 2 from the "Guide for Determining Time Requirements for Traffic Signal Preemption at Highway Rail Grade Crossings" located in the ADOT Traffic Engineering PGP Chapter 600, Section 628: Railroad Preemption and assuming a three percent grade. The additional APT for this crossing was calculated to be 44 seconds. The preemption calculation form is located in **Appendix C**. It should be noted that these calculations assumed that a new stop line will be installed 8 feet prior to the railroad automatic gate, there is no gate down circuit and included pedestrian clearance time of 29 seconds.

#### 6.1.2 Site Improvements

##### 6.1.2.1 Grade Crossing Advance Warning Signs

Currently, there is one grade crossing advance warning (W10-1) sign on Calle Sonora east of SR 19B. It is recommended that ADOT install additional Grade Crossing Advance Warning signs in advance of the grade crossing along Mariposa Road and SR 19B per the 2009 MUTCD Section 8B.06. It is recommended that a W10-1 sign be installed along Mariposa Road approximately 160 feet west of the stop line. Because the distance between the track and SR 19B is less than 100 feet, W10-2 signs are recommended to be installed along SR 19B. The placement of the grade crossing advance warning signs shall be in accordance with the Arizona Supplement to the 2009 MUTCD Section 2C.05 and Table 2C-4.



#### *6.1.2.2 Regulatory Signs*

It is recommended that ADOT install a STOP HERE ON RED (R10-6a) sign per the 2009 MUTCD Section 8B.09. Mariposa Road (SR189)/Calle Sonora experiences heavy truck traffic; therefore, vehicle queues may extend over the tracks based on the existing preemption system operation. The installation of a STOP HERE ON RED (R10-6a) sign may mitigate the vehicles queuing over the tracks.

#### *6.1.2.3 Pavement Markings*

There are no grade crossing pavement markings in advance of the grade crossing along Calle Sonora. It is recommended that Grade Crossing Pavement Markings be installed along Calle Sonora in advance of the grade crossing per 2009 MUTCD Section 8B.27.

Currently, no stop line prior to the railroad automatic gates is installed for either approach. It is recommended that the stop line located west of the automatic gates be removed and a new stop line be installed prior to the automatic gates to indicate the point behind which roadway users are required to stop when the railroad automatic gates are activated per 2009 MUTCD Section 8B.28. By relocating the existing stop line east of the automatic gates, the existing video detection will need to be extended to cover this area.

The existing pavement markings along SR 19B and Calle Sonora are old, fading in some locations along Calle Sonora, and have poor retroreflectivity. It is recommended that all crosswalk and stop line pavement markings along SR 19B and all striping along Calle Sonora 205 feet from the intersection be refreshed.

### **6.2 Mid Term Recommended Improvements**

#### **6.2.1 Preemption Operation Improvements**

##### *6.2.1.1 Preemption Operation Changes*

The intersection currently operates with simultaneous preemption. Advance preemption is recommended to be implemented instead of simultaneous preemption at this location to provide sufficient warning time to start and clear the design vehicle from the Minimum Track Clearance Distance.

The Advance Preemption Time (APT) was calculated based on the FHWA document titled "Railroad-Highway Grade Crossing Handbook – Revised Second Edition August 2007 Appendix I Preemption Calculation Procedures, Example from State of Texas". The preemption time needed to clear the tracks was calculated based on the worst-case conflicting vehicle and pedestrian phase (phase 6) and time shown below.



Minimum Green Time:	5 seconds
Pedestrian Clearance Time:	29 seconds
Yellow Time:	3.9 seconds
All Red Time:	3.0 seconds
Queue Clearance Time:	19 seconds
Minimum Separation Time:	+ 4 seconds
<b>Maximum Preemption Time:</b>	<b>64 seconds</b>
UPRR provided Warning Time:	- 20 seconds
<b>Advance Preemption Time:</b>	<b>44 seconds</b>

Based on the current calculations, the intersection will require 64 seconds of maximum preemption time to clear the tracks. Subtracting the 20 seconds of UPRR provided warning time from the 64 seconds of maximum preemption time, 44 seconds of additional warning time or advance preemption time is required from the railroad. Preemption time calculations are included in **Appendix C**.

According to the Arizona Revised Statue 28-1095, a vehicle transporter and the semitrailer it draws shall not exceed 75 feet while a truck-semitrailer combination shall not exceed 65 feet. It was assumed that a vehicle transporter would not be accessing Calle Sonora; therefore, the design vehicle of 65 feet in length was assumed to calculate a conservative track clearance time value. These calculations assumed that a new stop line will be installed 8 feet prior to the railroad automatic gate. The posted speed limit is 40 mph on SR 19B and Mariposa Road, west of SR 19B and 25 mph on Calle Sonora east of SR 19B.

It is recommended that new interconnect conduit be installed from the traffic signal controller cabinet to the railroad equipment housing.

#### *6.2.1.2 Maximum Preemption Timer*

It is recommended that a maximum preemption timer circuit be provided for the traffic control signal which will allow the traffic signal to exit the preemption sequence in the event the railroad warning system "fails-safe".

#### *6.2.1.3 Gate Down Circuit*

It is recommended that a gate down circuit be installed at this highway-rail crossing to prevent the traffic signal from leaving TCG interval until it is determined that the gates controlling access over the tracks are fully lowered.

#### *6.2.1.4 Traffic Signal Health Circuit*

It is recommended that a traffic signal health circuit be installed at this highway-rail crossing which provides an indication to the railroad active warning system cabinet when the traffic signals are in flashing mode or dark such as when the controller is in failure.

#### *6.2.1.5 Implementation of Preemption Operation and Maintenance Program*

ADOT and UPRR should jointly develop an agreement to provide a maintenance program. The maintenance program should include the following:

- Testing the maximum preemption time and gate lowering times;



- Revising the preemption program if conditions change;
- Providing and updating emergency contact names and telephone numbers in railroad and highway controller cabinets; and
- Annual joint inspection by the highway authority and the railroad.

It is also recommended that ADOT develop procedures to handle equipment failure such as when the traffic control signal enters flash or loses power as well as a temporary traffic control plan for construction activities that could result in queuing across the tracks.

## 6.2.2 Traffic Signal Operation Improvements

### 6.2.2.1 Pedestrian Treatment

It is permitted by the 2009 MUTCD per Section 4D.27 to shorten or omit pedestrian WALK and flashing DON'T WALK intervals for the purpose of beginning the clear track interval earlier. However, by shortening these intervals, some pedestrians may be trapped in the intersection facing oncoming vehicles that are clearing the tracks/crossing. Shortening pedestrian times may not be a viable option at locations where pedestrian traffic is very heavy.

The existing operation has pedestrian detection for each pedestrian movement across SR 19B. The calculated Right-of-Way Transfer Time includes a pedestrian clearance time of 29 seconds due to the high pedestrian activity at this intersection.

### 6.2.2.2 Turning Movement Restrictions

According to the ADOT Traffic Engineering PGP Chapter 600 Section 626, restriction of right and left turns on a red traffic signal may be considered when an intersection is within 200 feet of a railroad grade crossing and the signal controller is preempted during train crossings.

It is recommended that the existing northbound to eastbound right-turn movement be restricted during preemption by installing a NO RIGHT TURN blank-out sign on the signal pole on the southeast corner and on the signal pole on the northeast corner.

### 6.2.2.3 Battery Back-up

The existing traffic signal controller is not equipped with battery backup. It is recommended that a battery back-up system be provided in accordance with 2009 MUTCD Section 4D.27.

## 6.2.3 Site Improvements

### 6.2.3.1 Sight Obstructions

Three areas of the crossing should be kept free from obstructions:

- The area on the approach from the driver ahead to the crossing;
- A train occupying the crossing; and
- Active control devices at the crossing.





Existing vegetation can obstruct all three areas of the crossing listed above, especially for motorists along SR 19B turning right or left onto Calle Sonora toward the crossing. It is recommended that vegetation be removed or cut back periodically, improving the visibility of the crossing and associated traffic control devices.

## 6.3 Long Term Recommended Improvements

### 6.3.1 Traffic Signal Improvements

#### 6.3.1.1 Pre-Signals

According to ITE's "Preemption of Traffic Signals Near Railroad Crossings" pre-signals can be located to stop vehicular traffic before the railroad crossing where the clear storage distance (CDS) is 50 feet or less. Pre-signals can be used only after an engineering study determines that the queue extends into the track area. It is recommended that this highway-rail crossing be analyzed to determine if queuing vehicles extend into the track area and pre-signals should be installed to prevent vehicles from queuing across the grade crossing and stopping on the tracks in the MTCD. The timing and display of these highway traffic signals are integrated with the railroad's preemption program.

### 6.3.2 Site Improvements

#### 6.3.2.1 Illumination at Highway-Railroad Grade Crossings

It is recommended that an engineering study be completed to determine if better nighttime visibility of trains and a highway-railroad grade crossing is needed. The study should review if a substantial amount of railroad operation is conducted at night, train speeds at the highway-railroad grade crossings, and if crash history indicates that drivers experience difficulty in seeing trains or traffic control devices during hours of darkness. Crossing illumination and increased retroreflectivity on highway signs are possible mitigations that can be recommended from a nighttime visibility review.

#### 6.3.2.2 Pedestrian and Bicycle Improvements

As the surrounding area continues to develop and pedestrian and bicyclist pathways are constructed, non-motorist safety should be considered at the highway-rail grade crossing. To improve non-motorist safety at highway-rail crossings, passive and active devices may be used to supplement highway-related active control devices. Passive devices include fencing; swing gates; pedestrian barriers; pavement markings and texturing; refuge areas; and fixed message signs. Active devices include flashers; audible active control devices; automated pedestrian gates; pedestrian signals; variable message signs; and blank-out signs. Because of the variety of factors that may contribute to pedestrian hazards, a detailed study is recommended to determine the most effective measures to provide for pedestrian safety at this location when pedestrian and bicyclist facilities are constructed.

## 6.4 Improvements to be Completed by Union Pacific Railroad

Several improvements were recommended to the highway-rail grade crossing that would be completed by the UPRR. These improvements include:

- Raise existing equipment housing foundation to alleviate flooding issues; and



- Installing new interconnect conductors from the traffic signal controller to the railroad bungalow.

## 6.5 Cost

Preliminary cost estimates for traffic signal, signing and marking and ADA ramp construction were prepared for the short-term, mid-term and long term recommendations. This section summarizes the cost estimate for the recommended improvements. **Table 6** presents the cost estimate for intersection of SR 19B and Mariposa Road (SR 189)/Calle Sonora short-term, mid-term and long term recommended improvements.

Table 6: Recommended Improvements Cost Estimate

Recommendations	Costs
<i>Short-Term</i>	
Site Improvements	\$2,500
<i>Mid-Term</i>	
Pre-emption Operation Improvements	\$1,700
Traffic Signal Operation Improvements	\$20,700
Site Improvements	\$2,000
<i>Total Mid-Term Improvements</i>	<i>\$24,400</i>
<i>Long-Term</i>	
Traffic Signal Operation Improvements	\$35,000
Site Improvements	\$30,000
<i>Total Long-Term Improvements</i>	<i>\$65,000</i>
<b>Total Cost</b>	<b>\$91,900</b>



## **Appendix A:**

# **Federal Railroad Administration Accident Prediction Report**



# *Annual WBAPS 2013*

WEB ACCIDENT PREDICTION SYSTEM

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## Accident Prediction Report for Public at-Grade Highway-Rail Crossings

### *Including:*

Disclaimer/Abbreviation Key  
Accident Prediction List  
Collision History

### *Provided by:*

Federal Railroad Administration  
Office of Safety Analysis  
Highway-Rail Crossing Safety & Trespass Prevention

### *Data Contained in this Report:*

Crossing: 742037n'

*Date Prepared:* 7/23/2013



U.S. Department  
of Transportation  
Federal Railroad  
Administration

## USING DATA PRODUCED BY WBAPS

(Web Accident Prediction System)

1200 New Jersey Avenue, SE  
Third Floor West  
Washington, DC 20590

WBAPS generates reports listing public highway-rail intersections for a State, County, City or railroad ranked by predicted collisions per year. These reports include brief lists of the Inventory record and the collisions over the last 10 years along with a list of contacts for further information. These data were produced by the Federal Railroad Administration's Web Accident Prediction System (WBAPS).

WBAPS is a computer model which provides the user an analytical tool, which combined with other site-specific information, can assist in determining where scarce highway-rail grade crossing resources can best be directed. This computer model does not rank crossings in terms of most to least dangerous. Use of WBAPS data in this manner is incorrect and misleading.

WBAPS provides the same reports as PCAPS, which is FRA's PC Accident Prediction System. PCAPS was originally developed as a tool to alert law enforcement and local officials of the important need to improve safety at public highway-rail intersections within their jurisdictions. It has since become an indispensable information resource which is helping the FRA, States, railroads, Operation Lifesaver and others, to raise the awareness of the potential dangers at public highway-rail intersections. The PCAPS/WBAPS output enables State and local highway and law enforcement agencies identify public highway-rail crossing locations which may require additional or specialized attention. It is also a tool which can be used by state highway authorities and railroads to nominate particular crossings which may require physical safety improvements or enhancements.

The WBAPS accident prediction formula is based upon two independent factors (variables) which includes (1) basic data about a crossing's physical and operating characteristics and (2) five years of accident history data at the crossing. These data are obtained from the FRA's inventory and accident/incident files which are subject to keypunch and submission errors. Although every attempt is made to find and correct errors, there is still a possibility that some errors still exist. Erroneous, inaccurate and non-current data will alter WBAPS accident prediction values. While approximately 100,000 inventory file changes and updates are voluntarily provided annually by States and railroads and processed by FRA into the National Inventory File, data records for specific crossings may not be completely current. Only the intended users (States and railroads) are really knowledgeable as to how current the inventory data is for a particular State, railroad, or location.

It is important to understand the type of information produced by WBAPS and the limitations on the application of the output data. WBAPS does not state that specific crossings are the most dangerous. Rather, the WBAPS data provides an indication that conditions are such that one crossing may possibly be more hazardous than another based on the specific data that is in the program. It is only one of many tools which can be used to assist individual States, railroads and local highway authorities in determining where and how to initially focus attention for improving safety at public highway-rail intersections. WBAPS is designed to nominate crossings for further evaluation based only upon the physical and operating characteristics of specific crossings as voluntarily reported and updated by States and railroads and five years of accident history data.

PCAPS and WBAPS software are not designed to single out specific crossings without considering the many other factors which may influence accident rates or probabilities. State highway planners may or may not use PCAPS/WBAPS accident prediction model. Some States utilize their own formula or model which may include other geographic and site-specific factors. At best, PCAPS and WBAPS software and data nominates crossings for further on-the-ground review by knowledgeable highway traffic engineers and specialists. The output information is not the end or final product and the WBAPS data should not be used for non-intended purposes.

It should also be noted that there are certain characteristics or factors which are not, nor can be, included in the WBAPS database. These include sight-distance, highway congestion, bus or hazardous material traffic, local topography, and passenger exposure (train or vehicle), etc. Be aware that PCAPS/WBAPS is only one model and that other accident prediction models which may be used by States may yield different, but just as valid, results for ranking crossings for safety improvements.

Finally, it should be noted that this database is not the sole indicator of the condition of a specific public highway-rail intersection. The WBAPS output must be considered as a supplement to the information needed to undertake specific actions aimed at enhancing highway-rail crossing safety at locations across the U.S. The authority and jurisdiction to appropriate resources towards the safety improvement or elimination of specific crossings lies with the individual States.



## ABBREVIATION KEY

for use with WBAPS Reports

The lists produced are only for public at-grade highway-rail intersections for the entity listed at the top of the page. The parameters shown are those used in the collision prediction calculation.

RANK:	Crossings are listed in order and ranked with the highest collision prediction value first.
PRED COLLS:	The accident prediction value is the probability that a collision between a train and a highway vehicle will occur at the crossing in a year.
CROSSING:	The unique sight specific identifying DOT/AAR Crossing Inventory Number.
RR:	The alphabetic abbreviation for the railroad name.
CITY:	The city in (or near) which the crossing is located.
ROAD:	The name of the road, street, or highway (if provided) where the crossing is located.
NUM OF COLLISIONS:	The number of accidents reported to FRA in each of the years indicated. Note: Most recent year is partial year (data is not for the complete calendar year) unless Accidents per Year is 'AS OF DECEMBER 31'.
DATE CHG:	The date of the latest change of the warning device category at the crossing which impacts the collision prediction calculation, e.g., a change from crossbucks to flashing lights, or flashing lights to gates. The accident prediction calculation utilizes three different formulas, on each for (1) passive devices, (2) flashing lights only, and (3) flashing lights with gates. When a date is shown, the collision history prior to the indicated year-month is not included in calculating the accident prediction value.
WD:	The type of warning device shown on the current Inventory record for the crossing where: FQ=Four Quad Gates; GT = All Other Gates; FL = Flashing lights; HS = Wigwags, Highway Signals, Bells, or Other Activated; SP = Special Protection (e.g., a flagman); SS = Stop Signs; XB = Crossbucks; OS = Other Signs or Signals; NO = No Signs or Signals.
TOT TRNS:	Number of total trains per day.
TOT TRKS:	Total number of railroad tracks between the warning devices at the crossing.
TTBL SPD:	The maximum timetable (allowable) speed for trains through the crossing.
HWY PVD:	Is the highway paved on both sides of the crossing?
HWY LNS:	The number of highway traffic lanes crossing the tracks at the crossing.
AADT:	The Average Annual Daily Traffic count for highway vehicles using the crossing.



**PUBLIC HIGHWAY-RAIL CROSSINGS RANKED BY PREDICTED  
ACCIDENTS PER YEAR AS OF 12/31/2012\***

\*Num of Collisions: Most recent year is partial year (data is not for the complete calendar year) unless Accidents per Year is 'AS  
OF DECEMBER 31'.

RANK	PRED COLLS.	CROSSING	RR	STATE	COUNTY	CITY	ROAD	NUM OF COLLISIONS					DATE CHG	W D	TOT TRN	TOT TRK	TTBL SPD	HWY PVD	HWY LNS	AADT
								12*	11	10	09	08								
1	0.011900	742037N	UP	AZ	SANTA CRUZ	NOGALES	CALLE SONORA	0	0	0	0	0		GT	5	1	25	YES	2	4,027
TTL:								0	0	0	0	0								



**TEN YEAR COLLISION HISTORY AT PUBLIC AT-GRADE CROSSINGS ON THE  
ACCIDENT PREDICTION LIST**

Crossing	Date/Time	Railroad	City/hwy	Highway User/ User Speed	Type Track/ Train Speed	Weather	Circumstances/ View of Track Obstructed	Warning Devices/ Operating?	Interc/ Lights	# Killed / # Injured
Total Accidents: 0										

Total accidents this report: 0





## Appendix B:

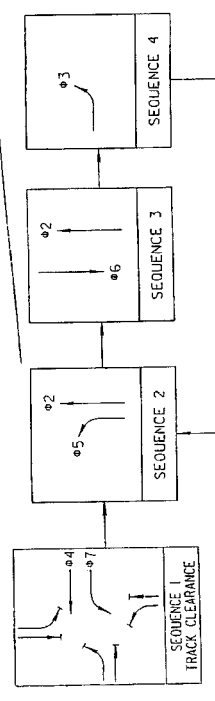
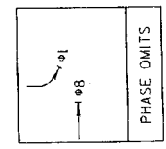
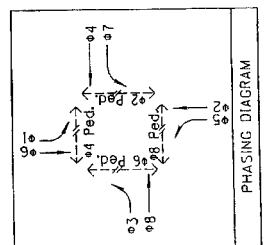
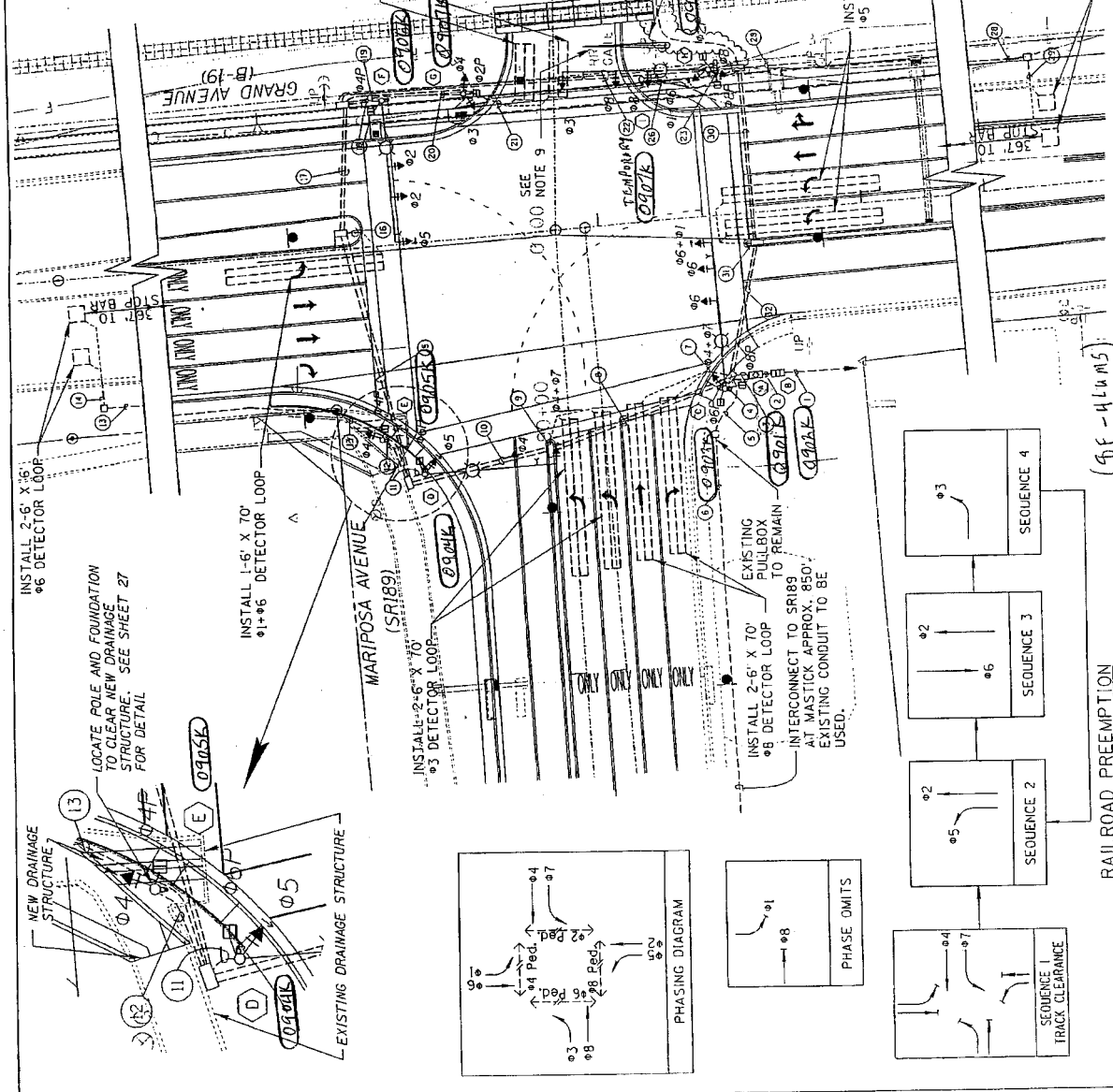
### Existing Traffic Signal Plans and Signal Timing

MP 2.65

STATE	PROJECT NO.	SHEET NO.	DATE
9	032-117P	24	33
189 SC 003			

### GENERAL NOTES:

1. ALL MATERIAL AND INSTALLATION SHALL CONFORM TO THE CURRENT EDITIONS OF THE STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION, THE "TRAFFIC SIGNALS AND LIGHTING STANDARD DRAWINGS", AND THE "CONSTRUCTION STANDARDS".
2. THE LOCATION OF UTILITIES SHOWN ON THE PLANS IS APPROXIMATE. ALL INVOLVED UTILITIES MAY NOT BE SHOWN ON THE PLANS. THE CONTRACTOR SHALL BE RESPONSIBLE PER SECTION 730-6 OF THE STANDARD SPECIFICATIONS FOR CONTACTING ALL UTILITIES FOR EXACT LOCATION PRIOR TO ANY CONSTRUCTION ACTIVITY.
3. ALL PULLBOXES SHALL BE LEFT IN A CLEAN, UNCOVERED CONDITION UPON COMPLETION OF THE WORK.
4. SEE STRIPING PLAN TO VERIFY ACTUAL LANE DIMENSIONS AND STOP BAR LOCATIONS.
5. ALL LOOP DUCT CONDUCTORS SHALL HAVE A MINIMUM 2" SEALANT COVERING FROM FINISHED ROADWAY SURFACE, INCLUDING LEAD-IN SAWCUTS. THE LOOP SAWCUT SEALANT SHALL BE THE EMULSIFIED TYPE PER THE STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS. LOOPS SHALL BE INSTALLED BEFORE FINAL PAVEMENT SURFACE COURSE.




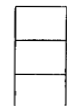
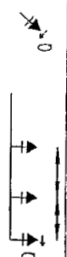


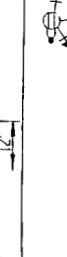
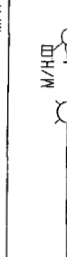
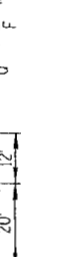

1-800-782-5348

ARIZONA DEPARTMENT OF TRANSPORTATION INTERMODAL TRANSPORTATION DIVISION	
DATE	03-28-2014
BY	03-28-2014
CHK	03-28-2014
REC'D	03-28-2014
TRAFFIC SIGNAL DESIGN	
SALE	
PROJECT NO. 032-117P	
SHEET 24 OF 33	

### RAILROAD PREEMPTION

INSTALL 2'-6" X 6" DETECTOR LOOPS

# POLE SCHEDULE

TRAFFIC SIGNAL CONTROLLER									
CABINET		TYPE	CONTROLLER	AUX. CONTROL		REMARKS	LOCATION		
	IV MODIFIED WITH ELEVATOR BASE			INSTALL P.E.C. AND 20 AMP FUSED LIGHTING CONTACTOR.		INSTALL CONTROL CABINET MOUNTED SERVICE ENCLOSURE PER T.S. 3-14.	APPROXIMATELY AS SHOWN ON PLANS. EXACT LOCATION TO BE DETERMINED IN THE FIELD BY THE ENGINEER.		
	METER PEDESTAL CABINET		--	--		INSTALL METER PEDESTAL CABINET PER T.S. 3-16.	APPROXIMATELY AS SHOWN ON PLANS. EXACT LOCATION TO BE DETERMINED IN THE FIELD BY THE ENGINEER.		
POLE									
		MAST ARM		SIGNALS		P.B. SIGN	REMARKS	LOCATION	
	TYPE	SIG.	LUM.	MTG.	FACE				
	R	55'	20'	3-II 1-V 2-XI	1-0, 2-F 1-0 2-M/H	T.S. II-4 (RIO-4(R)) (RIO-4(L))	250 W HPS, 240 V, LUMINAIRE, TYPE III MEDIUM CUTOFF	APPROXIMATELY AS SHOWN ON PLANS. EXACT LOCATION TO BE DETERMINED IN THE FIELD BY THE ENGINEER.	
	R	50'	20'	2-II 1-V 1-XI	1-0, 1-F 1-R 1-M/H	T.S. II-4 RIO-4(L)		APPROXIMATELY AS SHOWN ON PLANS. EXACT LOCATION TO BE DETERMINED IN THE FIELD BY THE ENGINEER.	
	A (10')	--	--	1-IV 1-XI	1-F 1-M/H	T.S. II-4 RIO-4(R)	--	APPROXIMATELY AS SHOWN ON PLANS. EXACT LOCATION TO BE DETERMINED IN THE FIELD BY THE ENGINEER.	
	A (10')	50'	20'	3-II 1-XI	1-R, 2-F 1-M/H	T.S. II-4 RIO-4(L)		APPROXIMATELY AS SHOWN ON PLANS. EXACT LOCATION TO BE DETERMINED IN THE FIELD BY THE ENGINEER.	
	A (10')	--	--	1-VI 1-XI	1-R, 1-F 1-M/H	T.S. II-4 RIO-4(R)	--	APPROXIMATELY AS SHOWN ON PLANS. EXACT LOCATION TO BE DETERMINED IN THE FIELD BY THE ENGINEER.	
	R	55'	20'	3-II 1-VII 2-XI	1-R, 2-F 1-0, 1-F 2-M/H	T.S. II-4 (I) RIO-4(R) (I) RIO-4(L)		APPROXIMATELY AS SHOWN ON PLANS. EXACT LOCATION TO BE DETERMINED IN THE FIELD BY THE ENGINEER.	
	A (8')	--	--	1-IV	1-M/H	T.S. II-4 RIO-4(L)	THIS POLE IS A TEMPORARY INSTALLATION AND IS TO BE REMOVED WHEN THE ULTIMATE CORNER CABINET IS INSTALLED.	APPROXIMATELY AS SHOWN ON PLANS. EXACT LOCATION TO BE DETERMINED IN THE FIELD BY THE ENGINEER.	

NOTES:

1. THE CONTROL CABINET SHALL BE WIRED AND LABELED WITH THE SAME NUMBER DESIGNATIONS FOR PHASES, AS SHOWN IN PHASING DIAGRAM AND AS NOTED ON THE PLANS. EACH CONNECTOR SHALL HAVE ALL PINS WITHIN THE CONNECTOR BROUGHT TO CABINET TIE PINS. ANY CONTROL CABINET NOT WIRED ACCORDINGLY WILL BE REJECTED BY THE ENGINEER.

2. THE CONTROLLER SHALL HAVE ALL THE SPECIAL PROGRAM APPLICATIONS PER STANDARD SPECIFICATIONS.

3. INSTALL P.E.C. AND 20 AMP FUSED LIGHTING CONTACTOR AS CALLED FOR ON THE PLANS AND THE SPECIFICATIONS.

4. ALL SIGNAL FACE LENSES SHALL BE GLASS.

5. LOCATION OF POLES, CONTROLLER CABINET, AND SIMILAR SIGNAL EQUIPMENT SHALL BE FIELD VERIFIED BY THE ENGINEER PRIOR TO ANY CONSTRUCTION ACTIVITY.

6. SPECIAL ADA PEDESTRIAN PUSHBUTTONS SHALL BE INSTALLED. SEE SPECIAL PROVISIONS FOR PEDESTRIAN PUSHBUTTON ASSEMBLY AND INSTALLATION REQUIREMENTS.


7. 3M MODEL 711 DETECTOR MOUNTED ON TOP OF POLES (1), (2), (3), AND (4). OPTICOM PHASE SELECTOR SHALL BE 3M MODEL 762 INSTALLED IN CABINET WITH M760 CARD RACK (DEPARTMENT FURNISHED).

REDUCED SIZE  
DO NOT SCALE

REDUCED SIZE  
DO NOT SCALE

## NOTES:

1. THE CONTROL CABINET SHALL BE WIRED AND LABELED WITH THE SAME NUMBER DESIGNATIONS FOR PHASES, AS SHOWN IN PHASING DIAGRAM AND AS NOTED ON THE PLANS. EACH CONNECTOR SHALL HAVE ALL PINS WITHIN THE CONNECTOR BROUGHT TO CABINET TIE PINS. ANY CONTROL CABINET NOT WIRED ACCORDINGLY WILL BE REJECTED BY THE ENGINEER.
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PROJECT NO. 032-117P		SHEET 25 OF 33	
DATE 8/9/89		BY 003	
			
ARIZONA DEPARTMENT OF TRANSPORTATION		INTERIOR TRANSPORTATION DIVISION	
TRAFFIC SIGNAL DESIGN		POLE SCHEDULE	
PROJECT SR 189		INTERSECTION SR 189/8-19	

INTERIUM  
100

[illegible]

\* THE IMSA 20-CONDUCTOR, 7-CONDUCTOR AND 4-CONDUCTOR CABLE SHALL BE #14 AWG IMSA 19-1. ONE 20-CONDUCTOR CABLE WILL BE INSTALLED FROM THE CONTROLLER TO EACH POLE IN A SINGLE UNSPUNNED RUN.

THE INSULATED BOND SHALL HAVE THE INSULATION STRIPPED INSIDE THE PULL BOXES.

CA	SPARE	SEARCH	STATUS
CABLE SHALL BE TAGGED DENOTING ASSIGNED PHASE.			

FLORIDA DEPARTMENT OF TRANSPORTATION  
INTERMODAL TRANSPORTATION DIVISION  
TRAFFIC SIGNAL DESIGN  
AND CONDUCTOR SCHEDULE  
SECTION SR 189/B-19

INTERSECTION SR 189/B-19

IMSA CABLE 19-1, #14 AWG,  
4 CONDUCTOR & 7 CONDUCTOR

SIGNAL HEADS	
INBOARD & SIDEMOUNT	
4 CONDUCTOR CABLE	
BASIC COLOR	SIGNAL INTERVAL
RED	RED
BLACK	YELLOW
GREEN	GREEN
WHITE	VEH. COM.

PUSHBUTTON		
4 CONDUCTOR CABLE		
BASIC COLOR	PUSHBUTTON STATION	
RED	PUSHBUTTON	
WHITE	P.B. COM.	
GREEN	SPARE	
BLACK	SPARE	

CA	SPARE	SEARCH	STATUS
CABLE SHALL BE TAGGED DENOTING ASSIGNED PHASE.			

# ARIZONA DEPARTMENT OF TRANSPORTATION-TRAFFIC SIGNAL TIMING CARD

Intersection: **B19 @ SR 189 (Mariposa)**

MP: **2.45**

Location: **Nogales**

MU #: **0900K**

Warrant: **UPDATE TIMING**

Timing As Of: **12/10/2012**

	PH 1	PH 2	PH 3	PH 4	PH 5	PH 6	PH 7	PH 8
Mvmnt	SB LT	NB	EB	WB	NB LT	SB	--	--
Min Green	6	15	8	20	6	15	--	--
Veh Ext	1.5	6.0	1.5	2.0	1.5	6.0	--	--
Max I	20	30	30	30	25	30	--	--
Max 2	--	--	--	--	--	--	--	--
Max 3	--	--	--	--	--	--	--	--
Walk	--	7	7	7	--	7	--	--
Ped Clr	--	15	27	30	--	29	--	--
Max Init	--	30	--	--	--	30	--	--
Sec Act	--	1.5	--	--	--	1.5	--	--
TBR	--	--	--	--	--	--	--	--
TTR	--	--	--	--	--	--	--	--
Min Gap	--	--	--	--	--	--	--	--
Guar Pass	--	ON	--	--	--	ON	--	--
Yellow	3.0	3.9	3.6	3.0	3.0	3.9	--	--
Red Clr	1.0	1.7	1.9	3.0	1.0	1.7	--	--
CNA	--	--	--	--	--	--	--	--
Det Memory	--	ON	--	--	--	ON	--	--
Dual Entry	--	--	--	--	--	--	--	--
Recall Mode	--	MIN	--	--	--	MIN	--	--
Ext Start	--	YEL	--	--	--	YEL	--	--

# TIME OF DAY FUNCTIONS

PGM	Funct'n	On	Off	Skip Days

# VEHICLE DETECTOR DELAY/EXTEND TIMING

Phase(s)	Ctrl/Amp	Type	Sec

# OVERLAPS      TIMING OPTIONAL

O/L(Phases)	Grn	Yel	Red
(A) 3	--	--	--
(B)	--	--	--
(C)	--	--	--
(D)	--	--	--

PHASE SEQ:      R1) 1,2,3,4      R2) 5,6

PROTECTED LEFT TURN PHASES:      1,5

PROT-PRM LEFT TURN PHASES:     

RAILROAD PRE-EMPTION: ☒      VIDEO: ☐

EMERGENCY VEHICLE PRE-EMPTION: ☐      LOOPS: ☒

COORDINATION: ☒

107 0900

PREEMPT DATA / PREEMPT #1

CONTROL

Non-Lock ..... 0-NO / 1-YES  
 Link PE # ..... 0-6 Preempt #  
 Delay ..... 0-999 Seconds  
 Extend ..... 0-999 Seconds  
 Duration ..... 0-999 Seconds  
 Max Call ..... 0-999 Seconds  
 Lock Out ..... 0-999 Seconds

INTERVAL TIMES

Selective Ped Clear ..... 0 0-999 Seconds  
 Selective Yel Chg ..... 3.9 0-99.9 Seconds  
 Selective Red Clear ..... 3.0 0-99.9 Seconds  
 Track Green ..... 6 0-999 Seconds  
 Track Ped Clear ..... 0 0-999 Seconds  
 Track Yel Chg ..... 3.0 0-99.9 Seconds  
 Track Red Clear ..... 3.0 0-99.9 Seconds  
 Dwell Green ..... 6 0-999 Seconds  
 Return Ped Clear ..... 0 0-999 Seconds  
 Return Yel Chg ..... 3.0 0-99.9 Seconds  
 Return Red Clear ..... 3.0 0-99.9 Seconds

Phase: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16  
 Exit Phase(s) ..... 1  
 Exit Call(s) ..... 1  
 Codes ..... 0 1  
 Non-Lock ..... NO YES Preempt Memory To Be Non-Locking  
 Exit Phase(s) ..... NO YES Phase(s) To Be Serviced First Following Preempt  
 Exit Call(s) ..... NO YES Phase(s) To Receive Calls On Preempt Exit

Notes:

If Track Green Time = 0, Then All Track Intervals Are Omitted.  
 Set Max Call = 0 To Disable  
 Lock Out Duration Will Be Dependent On Calls If = 0

PREEMPT 1 - OUTPUT STATUS

Phase Vehicle Phase: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16  
 Track Status ..... 1  
 Dwell Status .....  
 Cycle ..... 1 1  
 Phase Pedest Phase: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16  
 Track Status .....  
 Dwell Status .....  
 Cycle .....  
 Overlap Vehicle Overlap: A B C D E F G H I J K L M N O P  
 Track Status .....  
 Dwell Status .....  
 Cycle .....  
 Codes ..... 0 1 2 3 4  
 Vehicle ..... RED GRN FL R FL Y DARK  
 Pedest ..... DT WK WALK FL WK DARK  
 Cycle Vehicle ..... NO ACT'D MIN REC MAX REC  
 Cycle Pedest ..... NO ACT'D REC  
 Cycle Overlap ..... NO ACT'D

PREEMPT 1 - LOW PRIORITY ROUTINE

Non-Lock ..... 0-NO / 1-YES - When No Dwell Phases Are Set, This Routine Is Disabled.  
 Skip ..... 0-NO / 1-YES - Skip (Yes) Will Allow Phases To Be Skipped To Service The  
 Delay ..... 0-999 Seconds Dwell Phases  
 Extend ..... 0-999 Seconds - Set Max Call = 0 To Disable  
 Duration ..... 0-999 Seconds - Lock Out Duration Will Be Dependent On Calls If = 0  
 Dwell ..... 0-999 Seconds - Calls (Yes) Will Place A Ped Call On Exit From Routine  
 Max Call ..... 0-999 Seconds  
 Lock Out ..... 0-999 Seconds

Phase: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16  
 Dwell Phase(s) .....  
 Exit Call(s) .....

Dwell Phase(s) & Exit Call(s) Control Entry: "1" = Yes & "0" = No



## Appendix C:

# Preemption Timing Calculation Worksheet



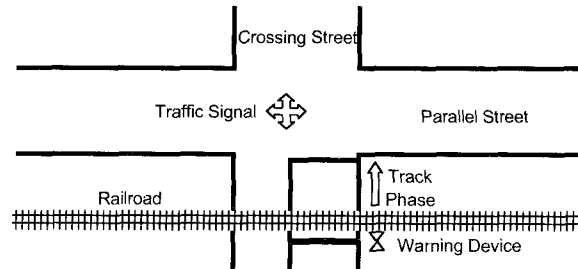


# GUIDE FOR DETERMINING TIME REQUIREMENTS FOR TRAFFIC SIGNAL PREEMPTION AT HIGHWAY RAIL GRADE CROSSINGS

Form 2304  
(03/09)  
Page 1 of 3

City City of Nogales  
County Santa Cruz  
District ADOT - Tucson

Date 01/06/14  
Completed by BMT  
District Approval \_\_\_\_\_



Parallel Street Name  
SR 19B (Grand Avenue)  
Crossing Street Name  
Mariposa Rd/Calle Sonora

Railroad UP  
Crossing DOT# 742 037 N

Railroad Contact Alexander Popovici  
Phone (602) 322-2510

## SECTION 1: RIGHT-OF-WAY TRANSFER TIME CALCULATION

### Preempt verification and response time

1. Preempt delay time (seconds) .....1. 0.0  
2. Controller response time to preempt (seconds) .....2. 0.0  
3. Preempt verification and response time (seconds): add lines 1 and 2 .....3. 0.0

### Remarks

Controller type: EPAC 300

### Worst-case conflicting vehicle time

4. Worst-case conflicting vehicle phase number .....4. 6  
5. Minimum green time during right-of-way transfer (seconds) .....5. 5.00  
6. Other green time during right-of-way transfer (seconds) .....6. 0.00  
7. Yellow change time (seconds) .....7. 3.90  
8. Red clearance time (seconds) .....8. 3.00  
9. Worst-case conflicting vehicle time (seconds): add lines 5 through 8 .....9. 11.9

### Remarks

### Worst-case conflicting pedestrian time

10. Worst-case conflicting pedestrian phase number .....10. 6  
11. Minimum walk time during right-of-way transfer (seconds) .....11. 5.0  
12. Pedestrian clearance time during right-of-way transfer (seconds) .....12. 29.0  
13. Vehicle yellow change time, if not included on line 12 (seconds) .....13. 3.9  
14. Vehicle red clearance time, if not included on line 12 (seconds) .....14. 3.0  
15. Worst-case conflicting pedestrian time (seconds): add lines 11 through 14 .....15. 40.9

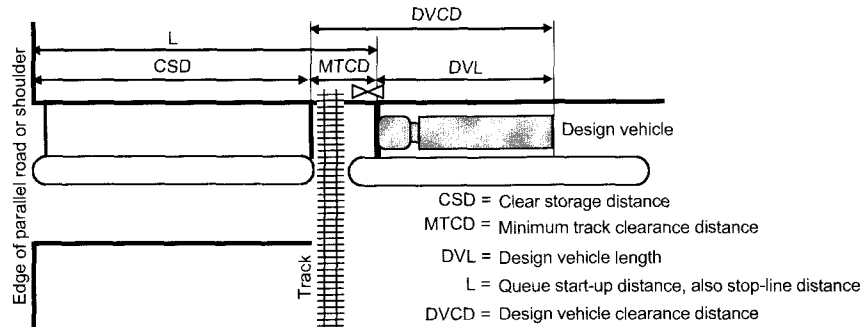
### Remarks

### Worst-case conflicting vehicle or pedestrian time

16. Worst-case conflicting vehicle or pedestrian time (seconds): maximum of lines 9 and 15 .....16. 40.9  
17. Right-of-way transfer time (seconds): add lines 3 and 16 .....17. 40.9

## SECTION 2: QUEUE CLEARANCE TIME CALCULATION

Form 2304  
(03/09)  
Page 2 of 3



		Remarks	
18. Clear storage distance (CSD, feet) .....	18. <table border="1" style="display: inline-table; width: 100px; text-align: center;"><tr><td>33</td></tr></table>	33	
33			
19. Minimum track clearance distance (MTCD, feet) .....	19. <table border="1" style="display: inline-table; width: 100px; text-align: center;"><tr><td>31</td></tr></table>	31	added 8' for stop bar location
31			
20. Design vehicle length (DVL, feet) .....	20. <table border="1" style="display: inline-table; width: 100px; text-align: center;"><tr><td>65</td></tr></table>	65	Design vehicle type: <u>Simi-Trailer</u>
65			
21. Queue start-up distance, L (feet): add lines 18 and 19 .....	21. <table border="1" style="display: inline-table; width: 100px; text-align: center;"><tr><td>64</td></tr></table>	64	
64			
22. Time required for design vehicle to start moving (seconds): calculate as $2+(L+20)$ .....	22. <table border="1" style="display: inline-table; width: 100px; text-align: center;"><tr><td>5.2</td></tr></table>	5.2	Remarks
5.2			
23. Design vehicle clearance distance, DVCD (feet): add lines 19 and 20 .....	23. <table border="1" style="display: inline-table; width: 100px; text-align: center;"><tr><td>96</td></tr></table>	96	
96			
24. Time for design vehicle to accelerate through the DVCD (seconds) .....	24. <table border="1" style="display: inline-table; width: 100px; text-align: center;"><tr><td>13.2</td></tr></table>	13.2	Read from Figure 2 in Instructions.
13.2			
25. Queue clearance time (seconds): add lines 22 and 24 .....	25. <table border="1" style="display: inline-table; width: 100px; text-align: center;"><tr><td>18.4</td></tr></table>	18.4	
18.4			

## SECTION 3: MAXIMUM PREEMPTION TIME CALCULATION

		Remarks	
26. Right-of-way transfer time (seconds): line 17 .....	26. <table border="1" style="display: inline-table; width: 100px; text-align: center;"><tr><td>40.9</td></tr></table>	40.9	
40.9			
27. Queue clearance time (seconds): line 25 .....	27. <table border="1" style="display: inline-table; width: 100px; text-align: center;"><tr><td>18.4</td></tr></table>	18.4	
18.4			
28. Desired minimum separation time (seconds) .....	28. <table border="1" style="display: inline-table; width: 100px; text-align: center;"><tr><td>4.0</td></tr></table>	4.0	ITE recommended value
4.0			
29. Maximum preemption time (seconds): add lines 26 through 28 .....	29. <table border="1" style="display: inline-table; width: 100px; text-align: center;"><tr><td>63.3</td></tr></table>	63.3	
63.3			

## SECTION 4: SUFFICIENT WARNING TIME CHECK

		Remarks	
30. Required minimum time, MT (seconds): per regulations .....	30. <table border="1" style="display: inline-table; width: 100px; text-align: center;"><tr><td>20.0</td></tr></table>	20.0	
20.0			
31. Clearance time, CT (seconds): get from railroad .....	31. <table border="1" style="display: inline-table; width: 100px; text-align: center;"><tr><td>0.0</td></tr></table>	0.0	
0.0			
32. Minimum warning time, MWT (seconds): add lines .....	32. <table border="1" style="display: inline-table; width: 100px; text-align: center;"><tr><td>20.0</td></tr></table>	20.0	Excludes buffer time (BT)
20.0			
33. Advance preemption time, APT, if provided (seconds): get from railroad .....	33. <table border="1" style="display: inline-table; width: 100px; text-align: center;"><tr><td>0.0</td></tr></table>	0.0	
0.0			
34. Warning time provided by the railroad (seconds): add lines 32 and 33 .....	34. <table border="1" style="display: inline-table; width: 100px; text-align: center;"><tr><td>20.0</td></tr></table>	20.0	
20.0			
35. Additional warning time required from railroad (seconds): subtract line 34 from line 29, round up to nearest full second, enter 0 if less than 0 .....	35. <table border="1" style="display: inline-table; width: 100px; text-align: center;"><tr><td>44</td></tr></table>	44	
44			

If the additional warning time required (line 35) is greater than zero, additional warning time has to be requested from the railroad. Alternatively, the maximum preemption time (line 29) may be decreased after performing an engineering study to investigate the possibility of reducing the values on lines 1, 5, 6, 7, 8, 11, 12, 13 and 14.

Remarks: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_